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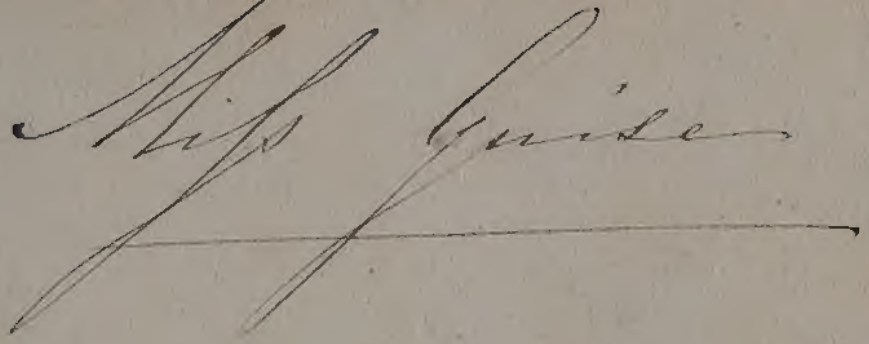

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THE MINE.

SALT.

CHESHIRE.

"THIS is something like!" James.—"Oh! this is quite a fairy palace! We seemed as if we were going out of the land of the living all the while we were coming hither: and now, surely, all I see is magic."

Mr. Thompson was well pleased to find his son thus interested and delighted. He had been at some trouble, and incurred some expense, to gain this sight for him. They were now in the subterraneous regions of the salt mine, at Northwich; and he had taken care to have the

whole illuminated, according to a custom with the miners, when company visit the mines, who are willing to pay for this splendid exhibition. Numbers of the workmen, with each a light in his hand, had placed themselves in the various niches and corners of the mine. As the mine itself is a very large excavation, great pillars of the salt rock are left at various intervals, fifteen, or even twenty-four feet in diameter, and as many in height; by which means, besides a huge vaulted dome, a continuation of chambers, halls, and passages, appeared in view. As the salt is like a white semi-transparent rock, every light glittered in a thousand places, exhibiting a great variety and intermixture of splendid colours;—much as one might suppose a vast building would display were the walls and arches encrusted with diamonds.

As these excavations reach far under ground,

some of the candles were evidently at a great distance, and gave the idea of an interminable labyrinth of brilliant apartments; although one vast amphitheatre, as the principal part, chiefly caught their attention. Here the floor was as level as any mason could have laid it; the sides rose to a cupola in the centre, supported by pillars nearly pellucid, almost fifty feet high.

This appeared the more astonishing to them, because their descent had been rather gloomy; for they were let down in a large tub, through a sort of deep well, about two hundred feet, and in rather an anxious mood. For the tub was only a rough one, — that which is used by the miners for raising the lumps of salt to the surface of the earth.

It was some time before the fascination of the scene would allow the young philosopher to ask

a single question, or notice any of the operations going on.

He began at last to inquire, with a whole string of questions: "How deep are we in the earth?—How far do these caverns reach?—How much is obtained from hence every year?" &c.—"It will take some time to answer all those questions," said his father; "which can be done, too, more at our leisure, when we get above ground again. Meanwhile, let us observe some of their operations."

When the extra lights were extinguished, and only those remained which the workmen needed for their convenience, the place looked gloomy enough, especially after its recent brilliant appearance.

"So," said James, laying hold of his father's coat, "the presiding nymph of the salt mines has been dethroned, I suppose! Her ladyship has lost all her jewels!"

It was curious to watch the miners in their work separating huge masses of the salt rock, with pickaxes; and then, with heavy hammers, splitting them into smaller and more convenient portions. In some places, they bored the rock, and put into the deep hole, thus made, a quantity of gunpowder: this being fired, an explosion followed, which usually separated several great blocks of the salt: these, as before, were broken, that they might be removed the more easily. These lumps, being brought to the spot under the mouth of the pit, were then drawn up to the open air, in that very tub in which James and his father had descended.

"So, James, we are now above ground again. If the landscape below is the most curious, yet, upon the whole, the landscape above is the most pleasant; is it not?"

"Yes, papa! I am glad I have seen the mine; but I am very glad now of the fresh air,

and the bright sun, and the smiling landscape, with its variegated greens."

"And now, some of your questions may be considered at leisure. You asked how deep we were below the surface of the earth? That grand cathedral, in which you were so much delighted just now, is about one hundred and fifty feet beneath us. But the depth of the several mines varies much. The salt rock seems to lie in vast beds, or strata. One of these had been worked for more than a hundred years, when another was discovered below it, but separated by a bed of hardened clay, or soft stone, between thirty and forty feet thick. This lower stratum is said to be very pure."

"And how came they to find this, thus deep in the earth, papa? Who told them it was there?"

"It was found, as we say, by accident. Persons were searching for coal, when they came to a solid mass of salt; which has been to the proprietors an inexhaustible fund of wealth. It is well those who were digging did not say, 'This is not coal, let us give over, and try somewhere else.' It is well that, when they had digged a hundred feet, they did not leave off in despair, and miss of this treasure. How much may be lost sometimes for want of perseverance! —And how much has been missed of by ignorance, which did not know the value of what it had found! It is said, that the bed of salt continues for a mile and a half, as measured one way, almost east and west, and about three quarters of a mile across it. The thickness of the stratum of salt is from fifty to almost a hundred feet. Its upper parts are about forty feet below the level of the sea. The thickness

of the lower bed of salt has not been ascertained; but they have sunk above forty feet into it, without finding its bottom. In another place, three distinct beds have been discovered. One of them four feet thick; a second twelve feet; and the third has been penetrated above seventy feet; but as no bottom has yet been found, we do not know how much deeper it is.

"There are several places hereabouts where salt is procured. They are most adjacent to the river Weever, which runs across Cheshire. The principal works are at Namptwich, Middlewich, and Northwich: there are also some at Winsford, and other places; making nearly a dozen mines, now in full working.

"Although the mine into which we descended is one solid rock of salt, which may be dug into, and brought up in lumps; yet, in many cases, the salt is found dissolved in springs of

Tell. Mein mir. Mellhorn!

water called *brine*. This must be rendered fit for use, by evaporating the water, which is done by boiling. As the water vanishes in steam, the salt crystallizes. Great pumps are in use at these brine springs, for bringing up the water from its deep caverns into large reservoirs; though some of these springs are at no great depth.

" Indeed, the rock salt itself is not fit for the table till it has been purified. This effect is produced by dissolving it in water, and then, by heat, evaporating that water again. The impurities rise as a scum to the top of the salt-pans. In order to facilitate this operation, coagulable matter, such as eggs, &c. are mingled with the brine ; these quickly rise to the top, in the form of a crust, and carry every foulness with them. Much of this purification is done on the spot; but vast quantities of the pit salt are sent to

Liverpool and Bristol, to be there refined. Much is also sent, in its crude state, to the Eastern side of the kingdom, where are long established salt works for supplying the adjacent country. It has been calculated that above fifty thousand tons of salt are extracted from the mines hereabouts, every year, supplying not only our own nation, but also Ireland and the Baltic, and so the north of Europe, with this necessary article.

"Thus the proprietors gain money *by* it; but in some countries they make money *of* it. It is thus precious in the central parts of Africa. The salt is formed into round flat cakes, which are stamped; and these are taken as ready money, in all the adjacent countries."

"One would wonder how all the salt came there," said James.

"True," replied the father: "men, who love to account for every thing, have guessed about

it. Many have supposed that it has been formed from gradual depositions from the sea. Yet, if that were the case, how are we to account for it, when found, as it is in some places, at considerable heights up mountains? Indeed, I do not know that sea-water, if left to settle, will ever deposit its salt. Unless it were over saturated with it, how could it let it go, if heat were not applied to evaporate the water? If this salt had ever floated in the sea, it must, in its crystallization, have inclosed in it fish, or shells, or marine plants of some sort; but we have no account of any such matters being found among it; yet its power to preserve them, if once inclosed, cannot be doubted.

"I am more inclined to suppose, that the masses of salt are part of the original creation, like the various masses of rock, and were intended for great usefulness in the economy of our

earthly habitation. Salt is acceptable to man in every climate, and to many animals: sheep and horses are fond of it; pigeons are kept to their dove-cotes, by a lump of rock salt being placed within their reach. In all nations, man is fond of it, and gives much to obtain it as a relish for his food. In ancient times, it was the symbol of friendship, and the test or bond of it. To have eaten a man's salt, was sufficient to bind the most furious passions. Thieves, who have broken into a house, with a design to rob and murder, on happening accidentally to taste the owner's salt, as they were exploring his premises, have been known immediately to withdraw; not being able to break through what they were accustomed to consider as a binding engagement to do him no injury.

"The manner in which salt is spread into countries far from the sea, shews a kind provi-

sion for our wants; and also militates against the notion of such masses having been produced from the saltness of the ocean. That it is found in high situations, has been hinted already. In Spain, near Cordova, is a hill much higher than St. Paul's cathedral, composed of salt through its whole substance. Another, of equal size, is found in India. The mines of Saltsburgh, in Austria, are far above the level of the sea; and the short duration of the Deluge cannot account for such vast accumulations. Poland has immense mines of it, as we shall presently see. In the mountains of the Tyrol, it is found; also in Russia, at the Betski mines, great quantities are procured. In the southern parts of Asia Minor, it is in such plenty, and is so hard, and the atmosphere so dry, that it is used for building. It abounds in the northern parts of Libya; and is plentifully stored in the mountains of Peru.

So widely spread as it is, so plenteously provided, it may fairly be supposed to be intended for important purposes, by Him, who knew what the wants of man would be ; and, indeed, what would be the occasions for it, in the globe, as an habitation."

" What, are these stores of salt of any use to the globe itself ?"

" Yes ; He who planned to give it so much sea, knew, that by saltness only, could the ocean be kept sweet. So far from supposing that these masses of salt were abstracted from the ocean, I think it much more likely, that the saltness of the ocean is occasioned by stores of rock salt at its bottom. We can trace these beds of saline substance upon the land, but the depths of the sea are hidden from us. There is nothing irrational, however, in the supposition, that there may be also mountains and layers of salt inter-

mingled with the mountains of rock, which form the bed of the sea. The continual agitation of these waters by the tides, will occasion a continual supply of the saline principle, if that be needful. The saltness of the sea is absolutely necessary, to preserve it from putrefaction. Accordingly, we find this saltness to be greater under the line, than near the poles. At the line, the great heat would tend more powerfully to engender putrescency, and there this grand preservative is most plenteously provided."

SEA SALT.

"And is all the salt used by the nations of the earth, obtained from a few salt mines?"

"No. This is called *rock salt*, or *native salt*; but much is obtained from the sea, by evaporation, which is termed *bay salt*. In all countries, where the sun is powerful, this is the common mode by which salt is procured. In France especially, there are several salt works of this kind, on the western coast, or Bay of Biscay. On some flat part of the coast, they dig large and shallow pits, generally of three depths, communicating with each other. Into the first, or reservoir, the sea water is let at high tide. Being thus confined in a very shallow state, the action of the sun evaporates the watery parts rapidly. The residuum is then let

The miner's cabin.

into the second, or brine ponds, which are more shallow, and on which the sun has therefore more power. This brine is afterwards let into the third sort of still shallower pits, called *salt pans:* here the water is not two inches deep. As the water evaporates, the salt, which cannot fly off, is left as a crust upon the sides of the pan; this is gathered up every day, and placed in heaps, which are thatched over, to preserve them from the weather. This work occupies from May to August. If the season be favourable, the manufacturer can thus obtain from the sea, in two or three weeks, salt enough for the whole kingdom. They also make much more, and export it to other nations.

The sun is scarcely hot enough in England for this process. Yet, in Kent and Hampshire, there are pits of this kind, in which the water is so far evaporated by the sun, that a much less

degree of boiling finishes the process, and produces the salt. The brine is made during the hot months, and kept in large cisterns, to be boiled at leisure. The boiling is sometimes continued till the end of the year.

SALT LAKES.

THERE are some lakes and morasses so impregnated with salt, that the sun alone suffices to produce it. A lake of this kind is found in Southern Africa, at a distance from the sea, and upon a height. In the rainy season, it fills with water, which becomes strongly impregnated with salt; in the hot weather, the water is evaporated, and the salt is left at the bottom of the lake, two or three feet in depth. In the island of Isonming, near the coast of China, the

earth is in some places so full of salt, that the natives dig it out, to the depth of a foot. This they carry to their salt works, where they soak out the salt with water in large shallow wooden vessels; and, by afterwards boiling the water, they obtain the salt pure.

SALT.

POLAND.

"But," said James, "what are the Polish salt mines, of which I have heard such wonders?"

"Several travellers have visited those mines, and have left us accounts of them: perhaps the substance of their descriptions may give us instruction and amusement.

"The mines of Cracow, as they are frequently called, are indeed eight miles from

thence, at a village named Wielitska, situated on a ridge of hills, adjoining the Carpathian mountains. The mode of descent into the mine, at the principal opening, is by means of hammocks, fastened to the great rope by which the loads of salt are drawn up. 'We were let down gently,' says Mr. Coxe, 'without any apprehension of danger, although the depth was almost five hundred feet;' (one quarter as high again as St. Paul's.) When they stepped out of their hammocks, they were not at their journey's end; for they had to descend a slope, which in some places was very broad; in others, the pathway was cut in the rock, into stairs; which were rather slippery, but, being wide, and glittering with the lights they carried, had the appearance of a grand staircase to a palace. To some lower places, the descent was by ladders. Every visitor carried a light, as did

each of the guides. The brilliance occasioned hereby was considerable and peculiar. Mr. Wraxall describes one vast chamber, in which a thousand people might dine; so large, that the flambeaux hardly enabled him to discern the sides; it seemed without limits.

"When fairly descended into the mine, the traveller finds an underground country. There is no sun, nor sky; but there are roads, with horses and carriages travelling in them; with multitudes of people, men, women, and children; many are born there, and pass in those caverns great part of their lives. The horses, once taken down, continue there, and never return to daylight any more; but are foddered and sleep in sheds cut in the salt rock.

"Many of the chambers are very large, supported by pillars of salt, left for this purpose; some of them are thirty or forty, and

some seventy or eighty feet in height, without any support except the sides. The roads and galleries branch out in many directions. In some parts, they are very intricate, so that persons whose light has been accidentally extinguished, have perished, not being able to find their way back again. The length already excavated exceeds a mile, and the breadth is nearly half as much. How much larger the stratum of salt is, cannot be known; the depth already dug is above seven hundred feet.

"Those who shew the mine are careful to point out to strangers the various elegant chapels hewn in the solid salt rock. The altar-piece, the ornaments, a large crucifix, and statues of the saints, are all cut out of the same glittering material; and, when illuminated for worship, have a splendid appearance. Mass

is said in them (for they are Roman Catholics) on certain days in the year.

"One statue is appropriate at least: it is a representation of Lot's wife, who was, you know, turned into a pillar of salt. This has been there so long, that most of the inhabitants believe it to be the very mass of salt formed on that occasion, with herself in the midst of it!

"It seems remarkable, that all these places, though formed of salt, are very dry. There is one rivulet of water running through the mine, which is originally fresh, but becomes saltish, by running in the channel which it has worn in the salt rock. The rock is hewn with pick-axes; much as in our English mines, in Cheshire.

"These mines have been wrought above six

hundred years; yet they have not come to the extremity of the stratum of salt, in any direction. About seven hundred persons are employed in them. Each continues at his work for eight hours, and then rises again to the surface, as they do not sleep in them. They have raised 600,000 quintals, or sixty millions of pounds weight in a year.

"While Poland had a king, he derived a considerable revenue from these mines; it is said, nearly £100,000 of our money every year. Since the partition of Poland by the neighbouring potentates, they belong to the Emperor of Austria. His officers, however, have in their avarice outwitted themselves; for, supposing Poland must have this salt at any rate, they have raised the price of it exorbitantly. The King of Prussia, seizing this opportunity to enrich his own subjects, imports great quantities

of salt into his own dominions, from other countries, which is carried into Poland, and sold to the people at a cheaper rate, than that which is dug up so near them. The mines of Wielitska, therefore, now only supply a small space of country, and their productiveness is much diminished."

"That serves the Emperor right, for his covetousness," said James.—"Rather, perhaps," replied Mr. Thompson, "the Emperor himself knows nothing about it. His ministers, or commissioners, have thus cheated themselves; it is a very common mistake."

ENGLISH MINES.

"How I should like to go abroad," said James, "and see all the mines in foreign countries!"

"That would be rather a long business," said Mr. Thompson; "it would exceed your present holidays."

"Oh yes, papa! But I should like it, I am sure. It would be so amusing and instructive!"

"Amusing came first, James, I believe, because it lies uppermost. If that be your object, I should think enough might be found in England to fill up your time, and empty my pockets. Those are two boundaries to our pursuits, which have a very powerful influence in circumscribing our actual conduct; and they should have their

influence in checking the wildness of our otherwise illimitable desires."

"Yes, papa, I am sure I am very much obliged to you, for bringing me such a journey as this; and procuring me the sight of such wonderful places. Only, I suppose, there are more wonderful places still abroad?"

"There are very wonderful places abroad, no doubt; but, why you should think they are more wonderful than those in England, I do not perceive. Though a mine be a little larger, or a little deeper, in one country, than in another; yet the sight of one gives as true an idea to the mind, as to the real nature of that sort of excavation, or that sort of mineral, as if you had seen twenty. You have been actually down into the salt mines at Northwich. The colour, the brilliancy of the salt, the mode of propping up the mine, the grandeur of the vast

cavern, and the hazards of descending into such a place, and coming up again; these and many other particulars, you know, and will never forget."

"That I shall not, I am sure, papa. How I was astonished and surprised! I never could have fancied what such a place was, in a thousand particulars, if I had not seen it myself."

"And did not that actual inspection enable you to understand the accounts I compiled for you, of the Polish salt mines at Wielitska?"

"Oh yes, papa, I was quite interested in that account; it was so curious: and, as you say, I understood it clearly, because I remembered what I had seen."

"Now England can furnish us with specimens of almost every sort of mine; and it has some peculiar to itself. A person, whose profession was mineralogy, might find it worth while

to visit even the mines of Potosi and of Kolyvan, though situated in different quarters of the world. But our object is only to obtain general knowledge, and especially to inform your mind on a point of so much importance. I am content to travel over England, therefore; it holds all we want."

"Yes, papa; I do not want, I am sure, to drag you either to Potosi or to (what do you call it?) Kolyvan. I am very thankful for what you are doing, and very much interested in what I am gaining."

"There is one particular, in which England excels most countries; that is, the machinery by which these grand works are conducted. The princely establishments of the various manufacturers, or mine proprietors, would not be found abroad. The scientific modes of operation, too, are much better understood and practised with

us. Not above two-thirds of the silver is obtained from the ore at Potosi, because the work is performed in an ignorant and slovenly manner. Then, the power of machinery can nowhere be seen to so much advantage as here. In Cornwall, there are steam-engines in full work, each of a thousand horse power, capable of raising fifty million pounds of water through the space of a foot, with only the expense in fuel of one bushel of coals. Such is the mode by which these gigantic machines are compared."

DIAMONDS.

EAST INDIES.

"You know the fable of the cock, who found a diamond necklace on a dunghill?"

"Yes, papa; and he wished it had been a grain or two of barley."

"Was he wise in that, James; or ignorant and silly?"

"I should have liked the diamond best, papa! How it would have sparkled on mamma's bosom!"

"Why, yes, James, the grain or two of barley would have been of no use to *you*. But, remember, I was not asking for *your* judgment, or *your* wishes, in such a case; but rather your opinion of chanticleer."

"Then, I think," said James, "he was quite in the right, to prefer somewhat which

was useful, to that which was merely ornamental, however splendid."

"Keep that opinion in mind, James; in the course of your life, it may save you many pounds. Yet, if nobody bought any thing but what is absolutely useful, many of the finer arts of life would be uncultivated, and the artists, who excel in them, must starve. So, let the dunghill-cock look after barley; neither he nor his pullets would be happier, nor indeed finer, for a diamond necklace. While, however, these bright gems are prized for ornament, (as that is the only use that can be made of them,) we may as well go on with our mining, and travel, by the help of books, into the countries where diamonds grow."

"Have we no diamond mines in England, papa?"

"We have some very brilliant stones, in several places; but no true diamonds. The

Bristol stones, found about St. Vincent's rocks, are in high repute, and deservedly, for their brilliance. Cornish diamonds are also in esteem."

"What! are real diamonds only found in the East Indies?"

"For many ages, all our diamonds came from the East; and, of course, they were very scarce. It was not till long after the discovery of America, that diamonds were found in Brazil. It has been remarked, that diamonds are found only in the Torrid Zone; and also that the Brazil mines are at the same distance from the Equator on its southern side, as those of the East Indies are on its northern side.

"The beauty of the diamond is greatest when you are unable to see it: that is, when it is so perfectly pellucid and clear, that the stone itself is not discerned, but only the brilliant ray of light, which its polished surface reflects.

" It is compared to a drop of perfectly clear spring water; and its denomination, when brightest, is, *a diamond of the first water.* When compared to water by weight, the diamond is found to be three and a half times more heavy than the purest water.

" As the mines in the kingdom of Golconda have been long in the highest esteem, we may as well begin our inquiries there.

" Raolconda is a principal mine, at five days' journey from the city of Golconda: it was discovered in the beginning of the seventeenth century. The country is woody and rocky, approaching the ranges of hills which run across the province. In the crevices of the rocks, is sometimes found a sort of vein of sand, not more than an inch wide, and frequently not above half that size; so that the miners are obliged to employ hooked irons, with which

Diamond washing at Jerusalo

they dig out the earth and sand: among this loose stuff, the diamonds are found. They wash it therefore with great care, securing all the stones it may contain. When the vein ceases, they split the rock still farther, by fire, and thus recover the vein, or find another, as the vein will run sometimes nearly a quarter of a mile.

"The value of these gems being very great, and the secreting of them easy, the miners are made to work quite naked. There are also persons incessantly on the watch, to prevent their concealing them. With all this vigilance, however, they are sometimes deceived; as the miners frequently swallow them, and thus get off with them without detection.

"The famous diamond belonging to the Great Mogul, was found in the neighbourhood of Gani, or Coulour, which is seven days' journey from

Golconda. The mine was discovered, about a hundred and fifty years ago, by a peasant, who was digging. He met with one diamond of twenty-five carats weight. That of the Great Mogul weighed, before it was cut, almost eight hundred carats. It is not common to find them above the weight of from ten to forty. The earth hereabouts is of different colours, red, green, and yellow; and the diamonds are frequently tinged with the same, which reduces their splendour, and, of course, their estimation.

"The importance of this mine appears in the number of persons employed in it, being frequently as many as sixty thousand. Their manner of operating is as follows: When, on examining the ground, they find a spot, which, to those accustomed to the search, appears likely to afford diamonds, they begin, in some place near at hand, to form a cistern, or pool, with clay; into this the women and children bring

the earth, which the men have dug out of the appointed spot. Here, with water, they loosen the earth, breaking the clods, and permitting the lighter mud to run off. The plain on which they operate, is about five miles wide, on the side of a river, between it and the mountains. When the miners come to water, they do not dig any deeper. The stony substances, which remain after the earthy particles are washed away, are carefully sifted, and then examined in a bright noon-day light. Those who are accustomed to it, will discover the diamonds by the nice feeling of their fingers."

"Then diamonds are always found by digging?" said James.

"Not so fast, James; the term *Mine*, in some cases, seems to intimate a place under ground; which is not the case at Gani, for there what is called a Mine, is of a quite different nature. Indeed, it is of all diamond

mines, the most ancient. It is situate in the province of Bengal, amongst the sands of the river Goual, which runs into the Ganges. Being near the city of Soumelpour, it is often called by that name. From this spot, those small but splendid brilliants, called *sparks*, are procured. The violent rains, which increase the torrents from the mountains, bring down from their bowels these precious gems. When these rains are pretty well over, that is, about the month of December, or possibly not till January, if the waters do not get clear, the operation of searching for diamonds commences. Frequently, ten thousand persons from the city and its neighbourhood assemble. To all ages and sexes, it is a sort of harvest; for the children can help. Those more accustomed to the search, examine the sands of the river, tracing them up to the mountains; as it is near

them that the larger diamonds are usually found. When they come to a place which they expect may be productive, they separate a portion of the sands, by making a dam in the river, all around the spot, with faggots, stones, and clay. After emptying the water out of this inclosed portion, so as to leave the sands dry, they dig to the depth of half a yard, or more; and carry what is dug up to a sort of cistern, walled in, near at hand, as before. There they wash it, and examine it carefully; trusting chiefly to the accuracy of their fingers, for discovering the precious pebbles.

"The river Succudan, in the island of Borneo, is said to abound in diamonds; but strangers are not permitted to go thither. Now and then, however, by great cunning and caution, some very excellent stones have been obtained by the Dutch, and sold at Batavia."

DIAMONDS.

BRAZIL.

"It was not till 1728, that the diamond was discovered in the Brazils, in South America. The manner of the discovery was thus:—The negroes, who were condemned to search for gold, often found, among the sand and gravel, little bright stones, which, not being gold, they threw away. Some of the miners preserved a few of these stones, and shewed them to the governor. As he had been in the East Indies, he immediately suspected them to be diamonds, and sent them to Europe, where, after being cut and set, they proved to be diamonds of very fine water, though not equal to those of Golconda.

"The place is called Serro-de-Frio, and is si-

tuated to the north of Villa Rica. The country round about seems to be impregnated with iron ores; and the earth, among which diamonds are found, is ferruginous to a considerable degree. The miners come to this bed of diamonds, as soon as they have removed the common vegetable soil. Connection with iron ores seems to be general in all the places where diamonds are found.

"At the river Jigitonhonha is the most important of the Brazilian mines. The course of the river is impeded by the miners, by a bank, raised by several thousand bags of sand. The pools thus formed are then pumped dry; the mud of the river is washed away, and the earth, in which they expect to find diamonds, is dug out, and carried for washing and searching. This is done with considerable care and regularity. They build a shed, formed of posts only, but co-

vered with thatch, to shelter the negroes while at work. This is usually nearly a hundred feet long, and almost half as wide. Into this, a current of water is made to flow, for washing the earth which they are about to search: and it passes the whole length of the shed. On the side of this are placed several wooden troughs, about a yard wide each. In every trough is a negro slave, with a rake contrived for the purpose; the earth to be examined, is raked into the trough, in the quantity of about half a bushel at a time; and the water is suffered to run into each trough in a gentle current. Meanwhile, each negro, with his rake, spreads the earth about under this stream of water. It is raked again and again to the upper part of the trough, that it may be thoroughly washed; which is known by the water running free from earthy particles. This effect is produced in

about a quarter of an hour, if the whole be kept in constant motion. What now remains is a sort of gravel. The larger stones, being of no value, are thrown away; it is only among the smaller ones, that they are likely to find diamonds.

"When a negro discovers a diamond, he immediately claps his hands, to give notice to the overseers: he then, holding it between his finger and thumb, presents it to them, and they immediately put it into a bowl of water. Three of these, sitting each on a chair, are placed to watch the process, that the negroes may not be able to secrete any for their own emolument. All these bowls of diamonds are every day carried to the principal agent, who weighs them, and enters in a book the weight and number of each day's process."

"Poor negroes!" said James: "that is

slaving for others, without hope for themselves!"

"Not quite so," said his father. "It sometimes happens that a negro finds a diamond of larger size than usual; one that weighs seventeen and a half carats: this is a happy day for him. He is directly crowned with flowers, and led in gay procession to the proper magistrate, who immediately pays the slave-owner the price of his liberty, and sets him free. He is also clothed; and may work on his own account. Smaller diamonds may gain rewards, if they exceed certain fixed sizes. If a negro is suspected to have swallowed one, he is kept in close confinement till the fact can be ascertained.

When these treasures were first discovered in Brazil, diamonds were obtained in great plenty. The first fleet from thence brought so large a

quantity, that orders were sent over from the Portuguese government, to decrease the number of hands employed in searching for them; lest their abundance should make them quite common things, and, by lowering the price of those already brought over, spoil the trade."

TIN.

CORNWALL.

"We have come over a rather dreary country," said James. "I do not much like those barren moors of Cornwall. What a continual up and down it was! There seemed to be no end to the hills; and they were all so wild, rugged, and bleak!"

"Every county in England has its spe-

cific character. Many smiling vales there are, rich in pasture and in grain; and many woody hills, with their dense darkness or thin light foliage flaunting against the blue sky, in the most picturesque manner; but, in general, we must not among such scenery expect to find mines underground. We are come in quest of subterraneous treasures; and these bleak unsightly moors promise well for our gratification."

James.—"And how strong the wind was, Papa! Yet I saw in some of the valleys beautiful myrtles in full blossom; such as we can hardly rear in our greenhouses."

"We are now near St. Austle: our immediate object are the Tin Mines at Polgooth, about two miles distant."

"What a number of mines are here!" said James; "if one may judge from the steam-engines."

"Yes. There are between twenty and thirty now in use. The descent into them is called *a shaft;* and above fifty shafts may be counted; though they are not all worked at the present day."

"What are those tall buildings for?"

"Those are the engine-houses. Water is always very troublesome in these mines. Sometimes, the workmen pierce a passage from the bottom of the mines, sloping downwards, to let the water off; this is called an *adit,* and is often the work of many years. But, frequently, they are obliged, at great labour and expense, to pump it out with steam-engines."

The young traveller was surprised too, at seeing so many heaps around every mining house; consisting of the ore as extracted, and thrown together.

"Persons enter these mines and come out again, as in most other mines, by the same conveyance as is used to bring up the ore; here called *a kibbut*."

The passing down in one of these, was attended with a little anxiety. James almost fainted away with apprehension; but soon recovered himself, when, once at the bottom, he felt his feet.

These kibbuts are raised and lowered by an apparatus at the top; either a large winch, or a wheel and axle. In some places, there are ladders, with landing-places at convenient distances.

They had come upon the principal vein, or *lode*, as the miners call it; and found it to be two yards thick. "In many places, the vein is, when first perceived, not above an inch thick, sometimes not above half an inch; but as they

follow it, it increases, and becomes more valuable. Towards the east, it has two branches; but it runs westward, seemingly, till it comes to the sea, at least. They have made their excavations to a good mile in length, but have not yet come to the end of it. They sometimes find pure lumps of metal, of twenty pounds weight.

"They have to blast the solid rock with gunpowder, in order to get at the ore conveniently. Frequently, the vein ceases abruptly, as if it had been suddenly snapped off; which seems to have been really the case, as experienced miners will soon discover the disconnected part, and proceed in their lucrative excavations. The remainder is usually found on one side, and at no great distance."

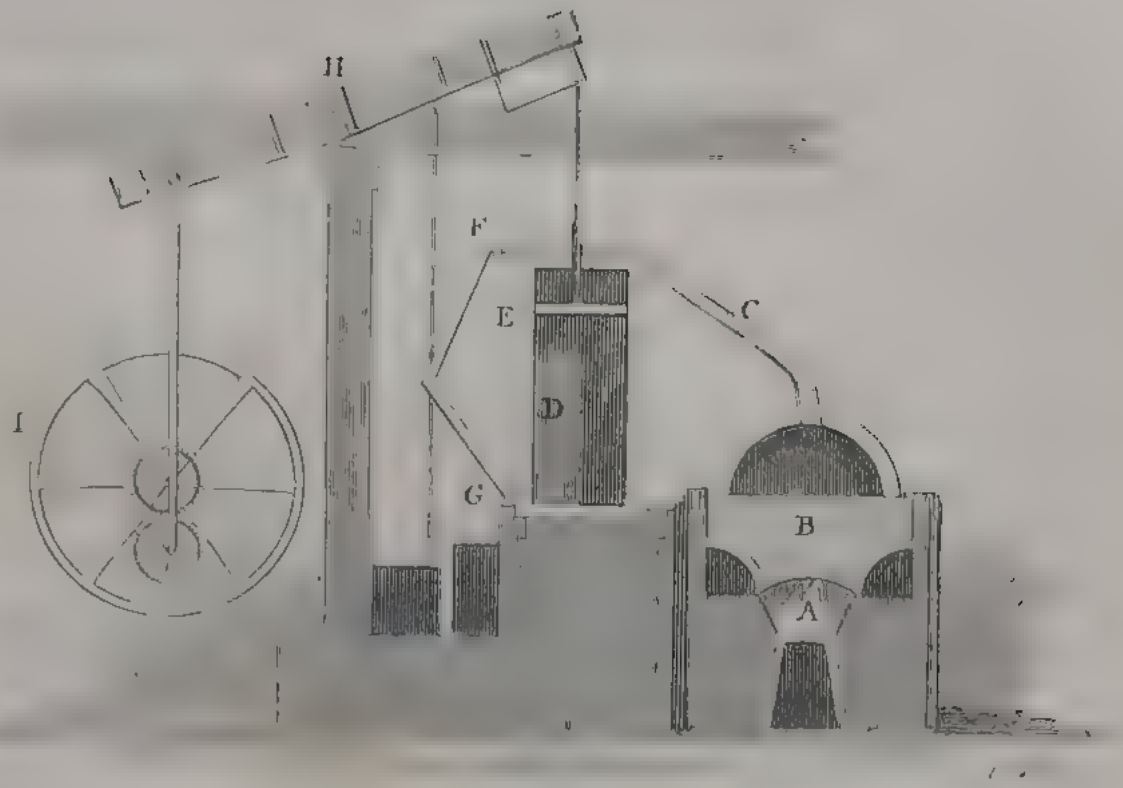
"And how deep in the earth are we now?" said James to one of the miners.

"Oh, Meastur, summer about fivescore fathom, or more, just here."

"Why, that is between six and seven hundred feet? Eh! it's almost like being buried alive. And do you work here day and night? —You can't tell which it is here?"

"No, Meastur, we doesn't only work four hours at once; and then belike another set comes down."

On examining the steam-engine, they found that every stroke drew up water thirty feet deep in the piston, which was fifteen inches in diameter; so that the discharge was wonderful. The expense of such establishments must be very great; but so are the profits. This mine has, in some years, cleared twenty thousand pounds.



Th. Thom Engin

EXPLANATION OF THE STEAM-ENGINE.

A. The furnace.

B. The water, which is kept boiling, to afford the steam.

C. The pipe conveying the steam.

D. The cylinder, in which the piston works.

E. The piston, moving up and down in the cylinder.

F. That part of the pipe which lets the steam into the cylinder, above the piston, when it is to be depressed.

G. That part of the pipe which lets the steam into the cylinder, beneath the piston, when it is to be raised.

H. The huge beam, or lever, to which the piston communicates its motion.

I. The fly and wheels, by which the up and down motion of the lever is made to become rotary.

Only such parts of the steam-engine are here represented, as may serve to shew the principle. The expansion of the steam forces the piston up or down, as it enters at the bottom or the top.

"At Dolgooth, the ore is found in a rich vein; but it is not always so. There are some, called *stream-works*, especially on St. Austle's Moor. It should seem that all the streams which run from the adjacent hills and settle in this valley, bring with them lumps of tin ore, larger or smaller, and have done so for ages. The soil also brought down by the waters has settled in the valley, till it has accumulated to the depth of from twelve to twenty feet. They dig into this artificial soil, and find several layers of earth, clay, and gravel; then they come to a stratum of stones, which, being heaviest, have sunk lowest, while the whole was moist and soft. Beneath these successive layers, they find other stones and gravel, which are the ores of tin; these are easily known by their being very heavy; some are lumps, as big as one's fist; some are almost as small as fine sand.

Below these, are the solid rocks; but in them is not any tin. The tin obtained from these stones is reckoned very pure, and is found in considerable plenty, having but a small proportion of refuse.

"These stream-works extend to Par. There the incumbent earth and sand form a stratum seventy feet deep. The miners bring streams of water to act upon it, with considerable violence, in order to wash the sand away; yet the pebbles are left at the bottom of the several channels.

"There are several mines of less consequence, though well worth the working, as at Gwennap, Illogan, Trevennen, &c.: but seeing one is essentially seeing all. These smaller works employ from a hundred to a hundred and fifty miners at each of them. One might reckon up nearly two hundred of those smaller concerns.

"The stream-works near Truro are said to yield eight thousand a year profit.

"These tin works are of different sorts, according as the tin is found: sometimes in the form of stones, very heavy, and very full of metal; sometimes the tin is mingled with earthy matter, almost as hard as stone, of a bluish or greyish appearance.

"When the ore reaches the surface of the earth, it is thrown into heaps. Here multitudes of the poor find employment in breaking it with hammers. In this broken state, it is carried to the stamping-mill, where it is pounded. In order to this, it is turned into a sloping trough, and a small stream of water assists it in sliding down into the case wherein the lifters work. These are pieces of timber, shod with large masses of iron: they are raised, and let fall again, by a water-wheel. The ore is re-

Breaking the Stone

peatedly washed before it is brought for melting. When melted, it runs into large oblong moulds, each of which contains about three hundred weight of pure tin. It must now be conveyed to some one of the Stannary towns, to be marked and assayed; or, as they call it there, *coined*. This is done by officers appointed by the Duke of Cornwall. They cut off a corner, and then stamp it with the proper seal, and the name of the melter. This gives assurance to the purchaser that it is pure tin, and tells all whom it may concern, that the duty has been paid. The duty is four shillings for every hundred weight; this goes to the Duke. The Prince of Wales is Duke of Cornwall; and his revenue, from this source, has been calculated at thirty thousand pounds a year.

"There are laws, called Stannary laws, by which all these mines are regulated. Every

case relating to them must be tried before their own courts, and cannot be removed elsewhere.

" If a person suspects that tin may be found in any certain spot of his own estate, he must obtain leave of the lord, before he can work it. If the spot be on some unoccupied moor, he may bound it; that is, make a pit at each of the four corners of the plot. No one can then operate on that piece of ground without leave from him, as well as from the lord of the soil.

" The share which the lord of the soil claims, called technically his *dish,* is about one sixth or one eighth part, free of all charges.

" The miners are not paid by the day, but by a share of the produce. This makes them careful to obtain all they can from the lode, and in as little time as possible.

"The whole conduct of the mine and of the miners is under the care of one person, called the Captain of the Mine. Besides knowing the proper methods of getting the ore out of the rock, he must understand something considerable of Mechanics, Algebra, and Geometry. He would be esteemed unfit for his office, if he could not at any time point out, upon the surface of the earth, the spot which is exactly over that at which the miners are operating: so that if it becomes necessary to sink another shaft, he may conduct it perpendicularly down to the very spot where it should come; though at a great depth in the earth, and notwithstanding all the windings of the mine below."

James was much surprised to find so much knowledge, as on several occasions he met with, in persons, who from their dress and labo-

rious occupation, he had supposed to be very ignorant. He several times wished he had his own geometrical problems more ready for use.

"Now, Papa, when we have seen any English mine, you tell me about similar mines in other countries. Where are the other tin mines?"

"We shall not have much to say about tin mines in other countries, James: for there are only three places in Europe where tin has been found: in Germany, in the mountains of Saxony; in Spain, near Portugal; and, the best of them all, those which we have now seen in Cornwall. In some parts of Asia, and in South America, it has been discovered; but not much of it has become an object of commerce, like ours."

"Some of the men said, these mines had been worked above two thousand years; is that true, Papa?"

"It is very likely to be true, James; for the Phœnicians are said to have traded hither for tin, more than five hundred years before Christ. That is, in the reign of Zedekiah, before the Jews were taken captive to Babylon. If so, that is more than 2300 years ago; and the man may be right.

"Some tin has been found in the island of Banca, near Sumatra, of which the Dutch have made their advantage. Some is found in the province of Nanking, in China; but it cannot be in any great quantity, because we, every year, export tin to China, to a considerable amount, from these mines in Cornwall."

COPPER.

CORNWALL.

"WHAT are those odd-looking horses, Papa? And what are they loaded with? And whither are they going?"

"They are mules," said Mr. Thompson. "A mule is an animal between a horse and an ass. They are preferred, as being extremely sure-footed. Each of them has, you see, a sort of wooden saddle, on which is laid a couple of dirty, dark-looking sacks. These are filled with copper ore, which is to be conveyed to the sea-side, in order to be sent to Swansea, in Wales; where it will be melted, and cast into moulds, ready for market.

"Having seen the tin-mines of Cornwall," continued the father, "we may as well look at the copper mines, now; for Cornwall is

Rain, or the Encamping Captive Ox.

famous for that valuable product, as well as for tin.

"Possibly the most important of these subterraneous treasures is at Dolgooth. Here again we meet with excavations a mile in length.

"Beneath, the earth is scooped and hollowed in every direction, almost like a honeycomb; only with less regularity."

They had to descend above twelve hundred feet, to the bottom; and then might choose almost any direction, which way soever they might prefer to go.

"Many steam-engines are employed here: some in bringing up the ore and the rubbish, and several in pumping out the water, to drain the mines. Some of these are so large, as to be denominated of a thousand horse power.

"Such expenses as are incurred by candles, tools, and gunpowder, belong to the miners, to

supply for themselves. They are repaid by a certain proportion of the copper raised from the mine, when it is actually sold; so that they are personally benefited by working the mine well.

"We may judge of the importance of these mines of copper, when we understand, that the persons in actual employ about them, of all descriptions, aged, and children, women, and men, are above sixteen hundred. The expenses are not less than fifteen or twenty thousand pounds a year. But then the produce is proportionably large, amounting, frequently, to between seventy and eighty thousand a year, in money.

"Perhaps we should not reckon much amiss, were we to suppose 100,000 persons employed in this one county, in bringing these treasures from the bowels of the earth."

"Do they ever find silver or gold in these mines, Papa?"

"Yes, sometimes; but not in any great quantities. Grains of gold have been found, like fine sand. And small quantities of silver. Although as much as was worth £2000 has been obtained near Gwinear, yet the expenses of procuring it were so great, that there was no profit to the proprietors, nor any thing sufficient to make it worth while to work them. They have therefore been discontinued.

"Much lapis calaminaris is found too, intermingled; this yields zinc. A mixture of copper and zinc makes brass; as a mixture of copper and tin forms bell-metal."

"We must not forget an ore called Mundic, or, sometimes, Marcasite. This was long neglected, and thrown away, as useless. Early in the last century, Sir Gilbert Clark found out

the method of producing from it very fine copper, to the value of nearly £200,000 per annum; so well employed is scientific knowledge, and so prodigal is ignorance; the latter throwing every thing away, however really valuable, because it does not know what to do with it! If education cost much, yet it may save a great deal, by banishing that ignorance, which passes by, or throws away, what might be useful; and giving that general knowledge, which may enable a man to take advantage of any thing which Providence may bring under his notice.

"Most of the Cornish mines are called *Wheels*; this, however, is not the true spelling, but *Huel*, an old Cornish word, signifying *hole*. Their names are often whimsical; as that called Dolgooth, was so named because the hole was opened near the dwelling of an old woman named Dorothy Koath, or Dol Koath. Huel

Providence, was named so, perhaps piously, because it was accidentally discovered. And Huel Boys, because the lode was first noticed by children.

"It was long supposed that tin was not worth working, when more than three hundred feet below the surface of the earth: but the best mines now in work go much deeper; some even to nine hundred feet.

"The tin mines were wrought long before those of copper were discovered. There was, indeed, a stony substance, which the miner found troublesome, thought useless, and threw away; it was called *poder*: and sometimes he abandoned the mine, when this was too plentiful. This was his ignorance. About the year 1735, a Mr. Coster, from Bristol, who had better skill in mineralogy, observing the heaps of this substance

which were thrown away, engaged to take it out of their way, and contracted for it at a low price. He soon found how to extract copper from it; and made so much use of his better knowledge, as to gain a fortune from their ignorance. Be careful how you throw any thing away; or, rather, endeavour to gain knowledge, in every varied shape, that you may not be liable to throw away any thing which may be really valuable."

COPPER.

ANGLESEA.

ALTHOUGH it was some time after their leaving Cornwall, that they visited our famous copper mines in the Parys Mountain, in Anglesea; yet, it may be more convenient to our readers,

Copper Mine Anglesea

if we put all of a sort together. We shall therefore proceed to relate what was found there worthy of notice, and exhibit the nature and importance of the mine.

In most mines, we have to descend deep into the bowels of the earth, and traverse its gloomy caverns by the flickering light of a candle, or a link, which threatens every moment to leave us in darkness. The miners work by a mere glimmer, and pass to and fro almost in the dark. But the Parys Mountain mine is quite different; it is open to daylight, and permits the sun and the fresh breezes to purify the atmosphere, and carry off the noxious vapours. Not but the air is still very offensive, in the direction of the wind especially, from the suffocating fumes of copper which arise on all sides. The whole country around, for miles, is desolate from the effects of these exhalations.

The first sight of the hill is dreary enough; being an assemblage of enormous rocks, hideously piled on each other, of the species called quartz. On ascending towards the top, the prospect opens of a huge bason, nearly half a mile across, or a good mile in circumference.

Persons had been searching for mineral treasures for a long while, and at considerable expense. They were on the point of giving up the search as fruitless, when, unexpectedly, in the year 1768, they met with a large mass of copper ore. This gave them fresh spirit for new exertions. The mines have been wrought ever since, to great profit; sometimes fifteen hundred men have been employed in them, who, with their families, may be reckoned as seven or eight thousand souls, whose living entirely depends on this produce.

This hollow is, on one side, filled with water ; over which, it is said, a bird is never seen to fly. It is most likely, that the fumes are so offensive, that they are disgusted, and so kept from danger.

" What a prospect!" said James ; " what a dreary prospect ! Being open to the daylight, one can see how hideous it is, so much the more plainly. This is very different from Llangolin Vale, where all was green, rural, and smiling. And see, Papa, what those men are standing on ! It is enough to make one giddy to look at them."

" O ! I see, they are scaffoldings, projecting a great way from the tops of the rock ; and there is a windlass at the end of each, by which I suppose they draw up—yes, there is one going

they draw up their baskets, full of ore, from the bottom of the pits.

"The rock is first of all split, by being blasted with gunpowder, as in most mines. It is said, that eight tons of gunpowder are thus used, in these mines, every year. The ore, so obtained in large masses from the rock, is broken with great hammers into smaller pieces, before it is drawn up to the surface of the earth."

The fumes most discernible were the sulphureous. The ore is much loaded with sulphur; this is driven out by fire. Heaps of copper ore were seen around, smoking and fuming, to the great annoyance of all who travel that way.

The ore, when thus far purified, is sent to places where coals are plentiful, in order to be melted, and run into moulds, fit for commerce. In this state they are called *cakes*, and in some places *salmon*.

"This is an amazing mass of metallic ore; perhaps there is not in the world another such.

It has been now worked for sixty years; and seems likely to last a long time, with an equally plentiful supply.

"In many places, there are waters, in smaller or larger pools. These are fully impregnated with particles of pure copper; indeed, the purest copper obtained is from these waters."

James was eager to see how this was done; and found, that the water is pumped up into pits, made on purpose for this operation. Then plates and pieces of iron are placed in them, and left. The acid, which had dissolved the copper, and holds it in solution, having a stronger desire for iron (a stronger affinity, chemists call it) seizes on it, and lets go the infinitely small particles of copper, which instantly fasten themselves on the iron. But the iron itself is soon dissolved by the acid, and falls down in a yellowish powder, leaving the copper in its place, and in exactly

the same shape as the iron, in whose room it has been deposited; so that the common people say, and believe, the iron has been changed into copper.

" Sometimes they take these pieces of iron out of the water, and carefully scrape the copper off them. The copper so procured is very fine. This water was once suffered to run waste; those concerned not being aware that any valuable use could be made of it. This copper is much more pure than that which is obtained by smelting. It is equal to what is called *virgin copper;* a name given to lumps, or branches, of pure solid metal, which they now and then find.

" Although it is only about sixty years ago, that we say this mass of copper ore was discovered, we ought rather to call it a re-discovery, as evident traces are met with continually of

this mine having been worked, many ages since; when all the knowledge in these matters amounted to heating the rocks violently by fire, and then suddenly deluging them with water; which occasioned them to crack, and scale off, so as to enable the workmen to break them in pieces, fit for melting."

Had our travellers happened to come hither in March, they would have found all parties in high holiday mood, as in that month the mine was discovered; the anniversary, therefore, is kept with great glee and joviality, down to the present time.

Their attention was excited by noticing a stratum of yellowish clay, which felt considerably greasy to the touch. This appeared to be very near the top, not a yard below the surface. The stratum itself was indeed, in some places, ten or twelve feet thick. This, it seems, is well

stored with the ore of lead; and this lead has in it a tolerable proportion of silver; as much as four pounds of silver in a ton of lead.

When they were at Ecton Hill, or Acton Hill, in Derbyshire, they found another copper mine, but of a peculiar kind, nothing like it having been yet discovered in the whole world. Other mines run a great length, or branch out in various directions; but this sinks down perpendicularly, widening as it descends, continually. It is situated near the river Dove, and was discovered about the year 1740. Those who first sought here for ore, spent £13,000, without gaining any benefit. They dug six hundred feet in depth, before they came to the ore. Then they found a rich supply; and a supply which increases as they descend. The works are four hundred and fifty feet below the bed of the river. It is the deepest mine in the British

islands. On the opposite side of the hill is an excellent lead mine.

Before we go absolutely abroad, we will just step over to our sister isle. At Wicklow, in Ireland, are copper mines; those especially at Cronebane, are considerable in their produce.

Copper is obtained in this kingdom too, by immersing iron in the water of the mines, by which process the finest sort is produced.

In the Wicklow lead mines, much silver is found; to the amount of one part in thirty. Lead ore is very frequently connected with silver.

Norway has mines of copper. That at Roraas, in the province of Drontheim, was discovered by a Laplander, travelling with his reindeer, in 1644. In some years, above six hundred tons of copper have been drawn from thence; but some of the veins have of late years

become deteriorated in quality, and diminished in quantity. Three hundred thousand tons of charcoal are consumed annually, in smelting the ore. The gang, or workable part of the mountain, is four or five feet thick; consisting of a gravelly soil, loaded with the copper ore.

COPPER.

SWEDEN.

We may take Mr. Coxe as our guide, in exploring the copper mines of Fahlun, in Sweden. He traversed those northern regions in the years 1784 and 1785. We find, by his account, that the general appearance of the country is desolate. We cannot have a fine harvest crop above, and a rich treasure of minerals below, at the

same place. Indeed, the number of smoking furnaces, which poison the atmosphere, are enough to impede vegetation, and blast the best appearance even of a kindly soil.

The copper mines at Fahlun are not only the best in Sweden, but they are among the best in the world. Swedish copper ranks high in the market; all our manufacturers are aware of its excellence.

Fahlun is situated in a hilly country, among dreary rocks, and also between two lakes of considerable size.

Very ancient records speak of this mine as having been famous in remote ages; so that it is impossible now to relate the story of its discovery.

The mouth, or entrance, of the mine, is very large, perhaps a thousand or twelve hundred feet in width; it is a vast chasm among the

rocks, which is continually enlarging as the parts around keep falling. The descent is rather hazardous, down several flights of wooden stairs to the first gallery; then it becomes so easy, that, though it consists of steps cut in the rock, the horses, who are used to it, can pass up and down them, as they go and come in bringing up the ore.

The miners have no clothing on their bodies, or arms; their naked appearance gives a sort of awfulness to the scene, which is heightened by the lights which every one carries about in his hand, consisting of small slips of wood, made into a bundle, and lighted.

The subterraneous galleries penetrate far into the bowels of the earth; they are from six to ten feet high, and of varying widths. Measuring the chasm from top to bottom, we find it above a thousand feet; and from the entrance

of the gallery to its lowest part, it is seven hundred feet more. It is true, there is a tolerably commodious staircase for a long way; then we come to a deep pit, into which the descent is by a wooden ladder; after this there is an iron ladder, hanging loose against the sides of the pit; then a wooden ladder again, reaching as far as one can go; as the bottom of the pit is full of water. It takes up four hours to pay this visit to the bottom of the mine: and the coming up again, such a length of way and by such means, is peculiarly dangerous and fatiguing.

The modes of operating in this mine are very similar to those in other mines. The rock is blasted with gunpowder; and the dissevered masses are broken smaller with hammers. The ore is roasted, in order to drive off the sulphur, and the remainder is smelted for sale. But this

roasting and smelting is repeated several times, in order to bring the copper to that high state of purity, for which Swedish copper is in such great repute.

Much copper is obtained here also, by the now common process of steeping iron in the waters of the mine.

Twelve hundred workmen are usually employed here; one half of them as miners in the bowels of the earth, and the other half in roasting, smelting, and other necessary operations belonging to the concern.

IRON.

FOREST OF DEAN.

"We have come some way through this Forest of Dean," said James; "I think the man was right, who said it was twenty miles long; though the ostler said that was its length formerly; but there is not so much forest now as there used to be."

"In Queen Elizabeth's time, when the Spanish Armada was sent over, the invaders were expressly commanded to destroy the Forest of Dean, because the best oak for our shipping grew there; however, Sir Francis Drake, and our brave admirals and sailors, would not let them, but defeated and dispersed their boasted *invincible* fleet."

As it grew dusk, their attention was attracted

by symptoms of their approach to the mining district; the forges were blazing and smoking on every side.

" Mines of iron are here, providentially, accompanied by mines of coal; these make the former of double value, because the iron ore can be smelted on the spot.

" Iron is never found pure, as are sometimes copper, silver, and even gold. It is, however, plentifully dispersed about our globe, and is one of its greatest natural gifts. Where there is no iron, there cannot be efficient tools; no arts can be carried on to any great extent, nor can sciences exist, nor can the cultivation of mind take place. The use of iron is the first step towards civilization, in all countries. Where this is unknown, the people are savages, and so must remain.

" The rusty brown stones, which are the ore

of iron, do not seem to promise much of value, either as to beauty or usefulness. But man has found out the means of making them of great importance, by drawing from them that most useful substance, iron; and again refining that into the most elegant articles of steel.

" The brown stones must first be roasted; this torrefaction brings them into a state, which renders their fusion a much easier and more certain operation, by expelling the sulphur, or arsenic, which abounds in the mineral state.

" It requires some instruction in the nature of the smelting furnace, to understand the process. The building, externally, is a huge cone, of solid masonry; for the weight to be sustained, and the force of the fire to be resisted, are both very great. Within this cone is a round cavity, narrowest at top; and the bottom of this cone holds the ore which is to be smelted.

Some notion may be formed of the greatness of the operation, when we find this hollow to be thirty feet in height, and twelve feet in diameter at the widest part, or towards the bottom; as the inside is somewhat of the shape of an egg, with the largest end downwards. The very top is shaped like a funnel, so that whatever is thrown in readily descends into the body of the furnace. It is at the top, that the labourers feed the furnace; by throwing in, alternately, baskets of fuel, and baskets of ore. The whole height of the furnace, with its fireplace, is above fifty feet.

"In former times, the only fuel used was charcoal; of which the consumption was so great, that our forests, which were decreasing very fast, could not supply the demand: indeed, the scarcity, and the increased price, threatened to destroy the whole iron trade. After many unsuccessful attempts, the managers contrived

to conduct the operation with pit-coal. The difficulty was, to obtain a heat sufficient for fusing the metal. Iron may be easily made red hot, but the heat must be raised far beyond that, to melt it, so that it may run into a mould. This effect is now produced by what is called a *blast furnace,* a wonderful contrivance, which has given a power of operation, and, of course, a value, to our mines, of incalculable extent.

" We all know that the operation of a pair of bellows will greatly increase the intensity of a fire; but what man, or set of men, could blow such bellows as should be applied to so great a mass as this? For some time, huge bellows were employed, of the usual shape, and worked by a water wheel; but a much more powerful blast is now obtained, by a piston working in a cylinder. By this means the blast is greatly increased in power, and the air is driven into the furnace in a very condensed state, which is

a great advantage. The cylinder is eight feet in diameter, and eight feet high, the stroke of the piston is seven feet. Now the orifices, or nose pipes, through which all this mass of air is at every stroke forced into the furnace, are only two or three inches in diameter. The violence of the blast may be supposed, though it can hardly be described. Its effect, when let into the furnace, is wonderful. It is not let in till the matters in the furnace are as fiercely hot as common fire can make them. When this powerful blasting begins, the roaring of the furnace becomes tremendous, and the effect upon the metal is irresistible. This blasting is continued for two hours.

EXPLANATION OF THE BLAST FURNACE.

A. The pumping cylinder, with its piston.

B. The regulating cylinder.

A
B
D
E

C. The pipe conveying the air to the furnace.
D. The furnace.
E. A man feeding the furnace.

"When the lava, or melted metal, has begun to run for some little time, it is let out into channels formed in sand, which lead it into hollows, formed also in sand, in which it settles and cools. It is then called *pig iron.*

"Iron ore is found in many parts of Britain; and as the nature of the mines, and other operations by which the iron stone is reduced to pure iron, are very similar, they need not be repeated at every mine.

"At Whitrigs, near Ulverstone, in Lancashire, are iron mines, which have been wrought four hundred years, and yet seem to be inexhaustible. There are immense beds of ore, from thirty to fifty feet thick, and from a hundred to a hun-

dred and twenty wide. The ore is red and greasy; those who are engaged in the works shew the colour on themselves very powerfully. Sometimes, two hundred tons are raised in a week; the metal produced from it is more than half the weight. Here the smelting is effected with charcoal; of which vast quantities are burned in the vicinity.

"There are mines of iron in Scotland: much of this ore is smelted at the Carron founderies. Here are twenty furnaces, which consume two hundred tons of coal every week. The place which, a few years ago, was a wild heath, is now a considerable town; as two thousand workmen are employed at the works. The machinery is of the most excellent kind, and wonderful in its operations."

IRON.

RUSSIA.

"We have great quantities of iron from Russia. The principal mines are situated in the Uralian mountains, which, towards the northern part of the eastern border, separate Russia from her Asiatic dominions.

"Here are above a hundred founderies; more than half of these are for iron, and the remainder for copper. The peasants, as is common in Russia, belong to the estate, whether private persons own the land, or the sovereign. Almost a hundred thousand of them work in these mines, at the will of their several lords.

"They raise, upon an average, nearly one hundred thousand tons weight of iron annually;

part of this descends, by the Wolga, to the eastern provinces; and the greater part of it is towed, through rivers and canals, to Petersburgh."

IRON.

SWEDEN.

"By all the feelings which belong to liberty, and associate with the name of Gustavus Vasa, the deliverer of Sweden, we must pay a visit to the mountains of Dalecarlia, where he lay hid so long, and whose hardy sons enabled him to resist the tyrannical Danish King, Christian II. Among those mountains, and in those mines, he wrought as a common labourer, till an opportunity occurred for his declaring himself, and engaging the miners on his side. The inhabit-

ants of those districts have a great veneration for his memory, to this day."

"I suppose," said James, "our visit, as usual, is to be paid by means of your library, while we sit by the fire-side."

"It will be most convenient. We shall employ several travellers; we have only to fancy, or, as children say, make believe, that we have sent Messieurs so-and-so to gain information, and to report to us.

"One of them says, the miners and blacksmiths of Sweden are well fed, and lodged comfortably; and he gives us such a picture, uniting vigour, activity, and contentment, as makes it pleasant to travel among their villages. When night comes on, the sensations are different, and almost terrific. The din of so many hammers at work all around, and the streams of light, and flame, and black smoke, issuing from so

many forges, powerfully impress the mind; even the clouds seem half on fire, from the red radiance.

" The most important of the iron mines is at Dannemora, which was discovered in 1488. The opening of the mine is of great extent, in which, here and there, are twelve pits; and down these the mining operations are carried on. These pits are deep excavations, like gravel pits, forming so many gulfs. The descent into them is by means of baskets, or buckets, attached to a rope, which passes over a pulley; much as if there were a projection from the top of Salisbury steeple, from which, in a basket, one could be let down to the ground.

" One traveller, speaking of this descent, says, ' The inspector of the mines accompanied me; I was accommodated with a chair, but he seated himself on the edge of the bucket, extending his legs, in order to maintain our equi-

librium. He had a stick in his hand, with which he occasionally pushed off from the edges of the rock, when we were in danger of striking against them. We were above five minutes making this perilous journey. The depth thus descended was five hundred feet. While I was thus descending, and hung in mid air, another bucket was ascending. I was so giddy, that I did not dare to look down; but as it passed us, I observed three girls in it, or rather on it, as they were each standing on the edge of the bucket, with great unconcern, and knitting all the while, quite at their ease. So much does custom take away the sense of danger. When I rose again, I closed my eyes, till I arrived safe at the surface."

"The motion of these buckets, up and down, is regulated by wheel work, moved by horses.

"The water is drawn out of the mine by

pumps, kept in motion by a wheel of great size, said to be above sixty feet in diameter. It is then conveyed away by an aqueduct, a mile and a half long.

" The length of these pits, adding them together, is about eight hundred feet; the breadth varies from three feet to twelve; the depth has been ascertained, in several parts, to be five hundred feet; but that does not reach the bottom in some places.

" This mine furnishes iron in high repute, as being the finest in the world. It is chiefly brought over to England, to supply our manufactories of steel and fine goods.

" The ore is dug in summer, and laid in heaps; in winter, it is removed on sledges to the several forges. The richest ore yields seventy per cent. of iron, the poorer sort not half so much.

" One of the principal forges is at Loefsta.

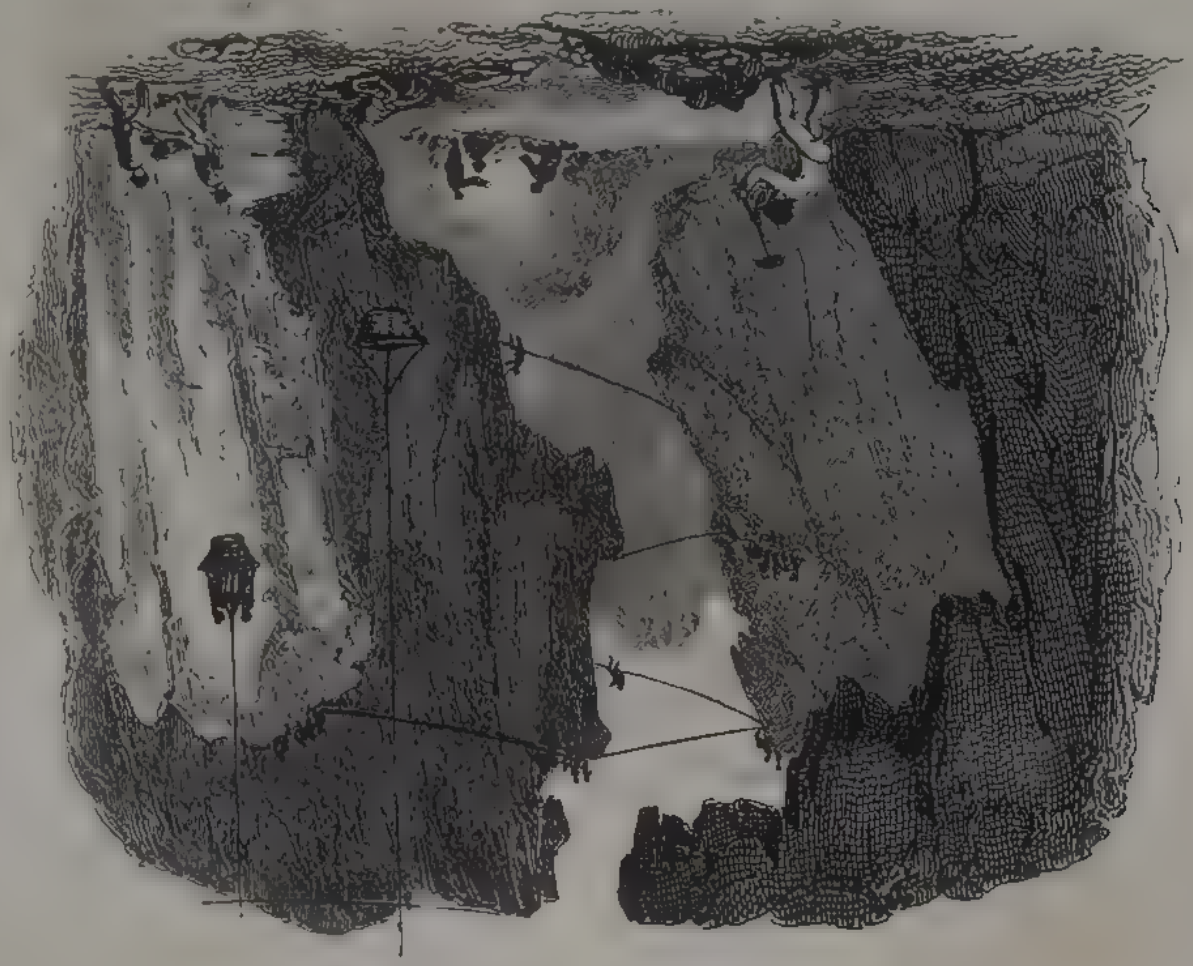
Here the numerous buildings, and the neat brick cottages for the workmen, make a pleasing appearance.

"Much as in other places is the operation of smelting performed. The ore is roasted, then reduced to powder by the mills; it is then melted, and, running into sand moulds, is cast into huge lumps, each weighing above a hundred weight. It is then heated and hammered repeatedly, till it is shaped into bars, from twelve to eighteen feet long, and from one inch broad to eight. In this state it comes to us.

"One remarkable particular, recorded by another observer, is the manner of obtaining the ore out of the rock; it is not dug out, as is commonly the case, but is all torn out by gunpowder. This operation takes place every day, at twelve o'clock, and is a most tremendous business. The explosion reverberates among

the hollow windings of the mine, like subterraneous thunders. The stones are thrown up, as by a volcano, to a great height in the air; and the concussion shakes the earth all around.

"This traveller descended also into the mine, by the same sort of dangerous conveyance, as the one to whom I have just alluded; and owns, that he shuddered, and half repented his curiosity; for, in him, it was nothing better. He was nine minutes in this state of suspension, before he reached the bottom. The view of the mine, he describes as awfully grand. Daylight was very faint at these depths; into many parts it could not penetrate; and they were obliged to use flambeaux. Frames of wood were stretched from side to side of the rock, in some places; on these, men were sitting astride, at great heights, boring holes for the next blasting. Should they lose their balance, they must fall, and be dashed to pieces.



"Though the weather was warm at the surface of the earth, yet amid these dark brown caves it was cold. In one of these caverns, considerably under the rock, was a charcoal fire, around which were eight miserable creatures, eating their meal and warming themselves. The warmth was a great refreshment, for the way was strewed with ice, almost every where in the mines.

"Some, who have been disinclined to this airy voyage in the bucket, have descended, in another part, by ladders. These are crazy things, and would be esteemed very dangerous, except as compared with the rope. They are also placed almost perpendicularly, from one projection of the rock to another. There is no small peril in this mode, as might be supposed, if the descent were from the top of St. Paul's; which is about the same depth."

COAL.

NEWCASTLE.

"CERTAINLY, now we are at Newcastle," said the father, "we must see how they make coals."

"Make coals!" said James. "Nay, Papa, they do not make coals; they dig them out of the earth, out of deep pits."

"I suppose we shall see," was the answer.

Accordingly they made the intended visit.

It happened, luckily, that a friend conducted them to a spot where they were that morning going to bore for coal, in order to discover if they might form a new mine. The boring rods are iron bars, each about an inch and a half square, and from three to four feet long; the

end is formed into a screw, so that the bars can be joined together, to any length that may be needed. At the end of the first, or lower bar, is a chisel, half a yard long, and about two and a half inches wide; and at the end of the upper bar is an eye, or loop, of iron, very strong, through which a long piece of timber is put, by which to turn the borer round.

James watched the operation, and saw that the men lifted up the borer a little way in the hole it had made, and then let it fall again, taking care to turn it a little round as it fell. It is a tedious business, especially when the stratum through which they are boring is very hard, a rock, for instance. The chisel soon becomes blunted, and must be drawn out, to be replaced by another. Indeed, they frequently draw up the borer, and put down a wimble, or sort of scoop, with which they bring up the dust

which the chisel has made; and from this dust they can tell what sort of substances they are boring through.

When they find coal, their first concern is to clear the water off; for all the joints and separations of the stratum of coal, in general, flow with water copiously. If the coal be so situated, as to height in the hill, that a drain or level can be led to it, this is the best way; unless the distance, or the hardness of the soil, should make it too expensive. In that case a steam-engine is built, to pump the water out.

When this is resolved on, they sink a pit, or well, about six or eight feet in diameter, below the deepest part of the stratum of coal: the water will naturally flow into this, and clear the mine, if pumped out as fast as it flows in.

When the engine pit is prepared, so that they

can draw off the water, they then drive the mine, so as to come at the coal.

We may here give the substance of Master James's letter to his Mamma, sent off by post the next day.

"DEAR MAMMA,

"OUR journey into the pit, (we being resolved to see it,) was, at least to us, rather adventurous. It will do better to read, than to repeat; as, by the fire-side, you will not be in danger, as we were.

"When we came to the opening of the pit, the first object which caught our attention was the thump, thump of an enormous steam-engine, which was employed to pump up the water out of the mine.

"Near this was a circular hole, down which we were to go; so filled with smoke, that we

could discern nothing else; it seemed like descending a vast chimney; and that too, while they were busy cooking below.

"We were first desired to dress ourselves: indeed, this seemed needful, unless we would utterly spoil our clothes; as to our faces, we knew, by experience, they could be washed. We put on, therefore, miners' jackets and trowsers, with caps over our heads; and, thus accoutred, we prepared for our suffocating journey. But how were we to descend? There were no stairs; but we found prepared, a log of wood, about three inches thick, and half a yard long; fastened by a rope at each end, so as to swing horizontally. This sling, or *horse*, as it is called, was slung by a hook to an iron chain. Each of us, therefore, had to put one leg through this loop, across the wooden bar, and lay hold tight of the chain, by which all was suspended; both of us went

together. We were then turned off the firm ground, and began swinging; and found ourselves gently sinking, by the turning of the machinery, which went by horses. In about five long minutes, for so they seemed to us, we felt the ground again; and got out, or off of, our what shall we call it—a carriage?

"Feeling our feet again, we began to perambulate; which we could do as easily as if in our drawing-room. Not that our dresses, or our black faces, would have been at all suitable for that. We seemed to be entering a vast suite of black chambers, supported and divided by regular pillars of immense size. The roof seemed only about seven feet high, and the chambers above twelve feet wide; but how far the stratum of coal reaches, they cannot tell, perhaps half under the county; at least, so they hope, and so do we hope too; for I don't know what

London would do for firing, if these coal pits were to fail.

" Now for our ascent:—it was by the same means as our descending. We were, however, surprised, when about half way up, to hear a voice say, ' How do you do, gentlemen?' We were so smothered in the smoke, we could see nobody; but we found it was a common joke, for some of the men to begin descending, and thus meet and surprise the half stupified travellers, in mid-way of their swinging."

In working the mine, a common practice is, to take away the stratum of coal only partially, leaving huge pillars of it to support the roof. When they have proceeded thus some way, they come back and work out those pillars; which occasions the earth above to fall in, and fill up the cavity. These pillars are not left at

random, but at regular intervals, and are of regular shapes; from twelve to eighteen feet thick. When they have wrought out all the pillars that they can safely remove, there will be left an eighth, or more, of the whole substance of the coal, which they dare not touch.

In one place, they saw horses employed in drawing sledges, loaded with great baskets filled with coal; five or six, and sometimes eight hundred weight, are drawn out at a time by one horse, if the slope be not too steep. A mine is made on purpose, having a gentle slope, for them, where it can conveniently be done. But the surprise of the party was not small, when, coming to a place where no such slope could be made, they found the poor horses were let down to their work, tied up in a net. Where the mine is not large enough for horses to work, the coal is removed by men, who drag

about half the load of a horse, on a low carriage of four wheels. In some places, neither of these modes are possible; so the coals are brought out by women, called *bearers,* who carry them in baskets, on their backs; the load is a hundred weight, and often more. And this is done in places where the ascent is so steep, that the carriage drawn either by horses or men, could not be used. This conveyance of the coal is to bring them from the place where they are dug out, to the bottom of the pit, which opens to the sky; this is sometimes a very considerable distance. There the coals are put into baskets, fastened to a rope, and drawn up by a sort of windlass, called a *gin,* put in motion by horses, or by a water wheel; or it is attached to a steam-engine, as may be most convenient at each place. The depth of some of the mines, below the surface, is often seven or eight hundred feet.

When the coals have fairly arrived at the open air, they are carried a small distance from the mouth of the pit; and sorted into three heaps, according to their sizes.

There are between twenty and thirty coal mines, in the neighbourhood of Newcastle. Some are within five miles of the river, and some almost twenty miles distant. To cart so heavy a substance all this distance, would cost so much, that coals in London would amount to double their present price. But knowledge is fruitful in expedients. Waggon-ways of iron are constructed, down which the waggons roll with great ease; so that one horse will draw as much as ten on a common road. A rail-road consists of two shallow grooves of iron, well fastened on stone work in the ground; or, sometimes, it consists of an iron ridge, so fastened; and then the iron wheel has a shallow groove to work upon it. The waggons are of a

funnel shape; and when one arrives at the wharf, a door in the bottom of the waggon is opened, which lets the coals down into the keel, or barge, which is placed properly underneath.

The keel is a clumsy oval-shaped barge. These receive the coals, and are rowed down the river, to the ships, which wait to receive them. The keelmen are a numerous body, rough and hardy; not fewer than six thousand. But it is calculated that almost seventy thousand persons are employed by these mines, in one way or another; and the capital by which these works are carried on, amounts to more than three millions sterling.

In one part of the mine, an accident had recently happened, called a *crash*. The pillars left to support the roof, being too slender, had failed; or else the floor of the mine was too

soft, and had suffered the pillars to sink in ; so that the roof fell in, with the whole mass of earth above it. This sort of accident seldom happens without giving notice, by previous cracks, and falling. In this case, the miners sometimes build up stone piers, to support the roof, if a falling in that spot would greatly hinder the work ; otherwise, they work away more of the coal pillars, and let it fall in gently.

Many dreadful accidents arise from foul air, of which there are two sorts : one, the black damp, is of a suffocating nature ; the other is inflammable, and, taking fire, explodes with great violence, or perhaps sets on fire the whole body of coal, so as to destroy the mine. They take great care, therefore, to bring a current of fresh air into the mine, which carries off the foul air, and does not suffer it to accumulate.

A few years ago, a dreadful explosion occurred at the Felling colliery, near Newcastle. These accidents are too sudden to allow of escape. More than one hundred persons, who were at work in the mine, perished in an instant. And nearly five hundred widows and children were plunged into distress and starvation.

Philosophy has, in modern times, endeavoured, with some success, to guard against this calamity, so terrible, so irresistible. Sir H. Davy has invented what is called a *safety lamp*, for the use of men working in the mines. It is composed of very fine wires, woven very closely together. The light passes between the bars, to assist the workmen; but the foul air is so dense, and, one might almost say, so ropy, that it cannot pass between the wires to get at the flame; and nothing but actual flame will set it on fire.

COAL.

SUNDRIES.

ALTHOUGH Newcastle has long been the grand source of our supply of coals for London, and the eastern coast of the kingdom, yet we have many other mines of this precious substance. Precious, Britons may well call it; for the plenty of it in our island has tended to raise England to its present importance, as a manufacturing nation.

It has been calculated, that as a mere commodity for sale, more value has been raised from our coal mines, than from the silver mines of Potosi, or the gold mines of Mexico. This value becomes enhanced to the nation, in an almost incalculable degree, by the uses to which coal is put in our manufactories. A hundred

pounds worth of coal employed in our steam-engines and iron forges, soon produces its thousands in some useful or ornamental article. The various fabrics thus brought to perfection, from the huge anchor of a man-of-war, to the delicate bobbinet-lace of a lady's fashionable dress, with numerous *et ceteras,* are beyond calculation. Were our coal mines to cease, nine-tenths of the activities of the empire must cease also.

"One would think," said James, "that, so much as they dig out every year, they must soon come to the end of the mine; and then, what should we do for coal?"

"That may become a serious question, some day," said Mr. Thompson. "Especially, considering that they have been digging here four hundred years; and that they now excavate to the amount of one million eight hundred thou-

sand chaldron every year, to supply London only: add to this what the eastern and southern coasts of the kingdom consume, and what is exported to foreign nations; and we shall make a total amount of two and a half millions of chaldrons, dug out every year."

"I hope it will last my time," said James.

"Our posterity may thank you for such a selfish wish; but such privation need not be feared yet awhile. Newcastle and its neighbourhood can supply us for four hundred years more: and there are many mines in other parts of the kingdom, some of which have never been worked, but which would become of value, if our present supplies should fail.

"One of the most remarkable mines of coal was found at Borrowstoness, in Scotland. This mine penetrated to a great extent under the sea. The entrance to it was situated half a

mile from the shore; it was built round, to keep off the waters, and ships could lie close up to take in the coal. Several springs of fresh water oozed into the works, but this water was drawn off by an engine, moved by the tide. For many years, this was a profitable concern, and brought great wealth to the Earl of Kincardine, to whom it belonged. The end of it was, however, very calamitous. An unusually high tide overtopped the mounds around the entrance; the sea rushed in, filled the mine, and drowned all who happened to be at work in it at that moment. It has not been wrought since.

"At Whitehaven, in Cumberland, is a mine very similar; as it runs under the sea to a great distance. The works are sunk almost eight hundred feet deep; and vessels ride at anchor, over the heads of the miners.

"A peculiar sort of coal, called *Cannel Coal*, is found in Staffordshire, Cumberland, and Lancashire. It is so hard, that it will bear turning in a lathe, to form boxes, and ornamental articles, as inkstands, saltcellars, candlesticks, &c. It is, however, chiefly used for burning, as it gives a remarkably clear flame, like a candle; whence its name, possibly. It is said that the chequered pavement of Litchfield cathedral is laid with cannel coal for the black squares, and alabaster for the white.

"Bovey Heath, in Devonshire, has a remarkable species, which bears its name, *Bovey Coal*. This has the appearance of having been wood: the same sort is also found in Scotland and in Iceland.

"A curious discovery was made, some years since, at Ballycastle, in Ireland, of an ancient

coal mine. The colliers were carrying a new adit; and meeting with a stratum of rock, they bored through it. They then perceived they were entering into a vast cavern. As the opening made was as yet but small, they caused a couple of boys to creep through with lights, to discover to what and where they were come. These soon lost themselves in the windings of the cavern. The workmen then enlarged the hole, and went after them, and perceived that they had entered a mine, which led them a long way, and branched off into many chambers, which had been worked ages before, as no traditional remembrance or history of any coal mine there, was in existence. Pillars were left to support the roof, much after the modern custom. Some remains of tools and baskets were found; but so decayed, that they crumbled to dust, on being touched. That it was long, long ago that these chambers had been

worked, was evident, as stalactite pillars were formed by the dripping of water through the rock above; some of them reaching to the floor. Such pillars, of such a size, could only be formed during the lapse of many ages.

"In Scotland, there are many coal works.

"Near Dysart, is a collection of collieries, remarkable for having many of the beds of coal on fire, which have been burning for two centuries. At present, the heat only warms the earth, so as to prevent snow from lying long on the surface; but, in times past, there was smoke by day, and flame by night, to a very awful degree.

"A traveller, who visited the Dysart mine, writes thus: 'I have made a journey lately where there were no trees, no fields; there was a river indeed beside us, but no fish ever swam in it; and in the air far around no bird has ever been known to fly! I have been in the coal

mines at Dysart. I repaired to the inspector's house, and was dressed. Conceive my slender body wrapped in a sailor's jacket and trowsers, which had been made for a stout man. I was crowned with an immense old hat, which had an irresistible tendency to rest upon my shoulders. After half an hour's walk in this fantastic attire, during which time I afforded some merriment to the natives, we reached the place of descent. It is a perpendicular shaft, with a wooden partition in the middle, reaching to the bottom. On one side of this partition are placed short wooden ladders, in a zigzag direction, from top to bottom of the pit.

"'Having each lighted his candle, we began to descend, and were right glad, after some fatigue, to find we had reached the bottom. We were at this spot still half a mile from the shaft where the coals are taken up. My

friend led the way with a lantern; we soon began to perceive that we had entered a spacious gallery, the roof being about twelve feet high. By the glimmer of our candles on the right hand, the wall seemed to be solid; but on the left now and then appeared a spacious gloomy cavern, which seemed to turn at right angles to the route we were pursuing; but how far we could not tell, it was all impenetrable darkness. We were then walking in what the miners call *the level.* On our side, a river flowed, fed by streams from various caverns, or sometimes by a waterfall, where the roof had given way. Hitherto the murmur of the stream had alone broken the dreary stillness of these caverns, and the feeble rays of our candles only made visible the darkness which they could not dissipate. But now other sounds and lights began to burst upon us: a fire was seen blazing at a distance,

and a number of motley faces danced and gleamed before us, like the figures of a magic lantern. The clanking of chains and the trampling of horses, were now distinctly heard; and a hollow sound, as of distant thunder, grumbled through the subterranean vaults, as the loaded baskets were dragged along.

"'We had now, in fact, arrived at the pit, where the coals are raised by a steam-engine. We had not yet travelled over half our ground, but the remainder of the journey was more expeditious. A train of empty baskets was ready to move, in which we made ourselves comfortable seats with straw. Our horse was harnessed, our light adjusted, and in a few minutes we started at the full trot, to explore the yet unseen recesses of this seemingly endless labyrinth. After travelling another mile, we arrived at the place

where the men were at work. Here the air was very close, from the smoke of their lamps; and we were glad to make our way back on loaded baskets, though contrary to the laws of these realms. We took no candles in returning, as a lamp is attached to each train of baskets. By accident, this only remaining light went out about the middle of our journey, and we were left in darkness, of which those above ground can form no conception. Our horse continued to canter along, as if nothing had happened, at a rate which made it a little difficult for me to keep my seat. In some time, a twinkling lamp appeared at a distance, on passing which, things went on as before. The baskets we travelled in are set on wheels, which move in a railway. The horses are in excellent condition, and have good stables in the

mine. They never see the light of day from the time they are first lowered down. Our return need not be described any farther.'

"The kindness of Providence to nations is seen frequently in the produce of the earth; some on the surface, and some deep in its bowels. England may well be thankful on both accounts. Whose harvests can be richer, for the food of man; whose perpetual green more beauteous or more serviceable, for the support of cattle? Many are the treasures too beneath the soil; of these, iron, and coal to work it with, are among the most precious.

"It is distributed in vast beds, or layers; not at any impossible depth, beneath the surface. It spreads to a great breadth, and is found under many counties, especially in the western and northern parts of the kingdom.

"Under Henry III. about the year 1239, a

charter for digging coal was granted to the town of Newcastle. But, about seventy years afterwards, the bringing of coal to London was forbidden; for at that time many large woods were growing in the neighbourhood of the city, from which it was supplied with fuel; and the coal was complained of as injurious to the land owners."

JAMES. "We don't know how to conceive of woods in the vicinity of London, now, Papa."

"No. Yet St. John's Wood was famous for its size, and for being the haunt of robbers too; though its situation was not a great way from the city."

GOLD.

We, who have the mines of coal and iron, need not envy other countries, which boast of mines of silver or gold; since, by our products, we obtain theirs; and that without violence, by the mere skill and industry which we exhibit in our fabrications, either of usefulness, or of elegance. To obtain these, they cheerfully part with their golden treasures. Indeed, considering the case rightly, it may be stated thus: we employ the Spaniards, the Portuguese, &c. to dig the mines, and bring us their gold; we pay them for so doing with something of less value to us, though of greater value to them, in the shape of cloth, implements, &c. matters for necessary wear, usefulness, or ornament.

Nevertheless, gold is a very useful commo-

dity: especially as, by the coining it into money, it becomes the agent for procuring almost every thing else, which has, or is supposed to have, the power of contributing to our welfare, or our gratification.

Gold is one of the purest of metals; and, on that account, not liable to perish by rust, or by fire. It is malleable, ductile, resplendent, and the most weighty of them all: half as heavy again as lead, and more than nineteen times the weight of water, bulk for bulk.

Gold is found in primitive mountains, usually in slender veins, often penetrating the hard rock itself. But it is more commonly obtained in small grains, from alluvial soil, that is, such as forms the beds of rivers, or those sides of them which have been created by floods, and are frequently covered with water. Many have supposed that these fragments have been wash-

ed down from the adjoining mountains; persons have frequently endeavoured to trace them up to their original beds in the mountains, hoping to find the parent vein, and become rich at once. They have, however, been disappointed. Nay, where the sands of the rivers afford golden grains, these particles have become more scarce as the searchers approached nearer to the rocks from which the streams have issued. The gold, indeed, appears only in patches: it is not the whole stream which affords the particles of metal, but only some particular districts, through which it passes.

The term "Mine," which seems to imply some hollow, artificially excavated beneath the mountain, must in this instance be transferred to places where they merely dig up the surface of the soil, and wash it, in order to separate the earth from the precious grains.

GOLD.

SUNDRIES.

The most ancient gold mines, of which we have any account, were in Spain, in the northern provinces. Thither the Phœnicians used to repair for the precious metal. The Romans also, when they conquered Spain, employed the native Spaniards to dig their own mines for them; much as, in later times, the Spaniards have forced the Indians of South America to dig for them. Those mines in Spain were veins of gold, to be dug out of the rocks, but they have been long neglected; indeed, ever since the discovery of America has enabled them to obtain gold in a more easy and plentiful manner. In the time of Nero, fifty pounds of gold were obtained daily

from the mines of Dalmatia. It was found on the surface of the ground. The island of Thasos, in the Ægean Sea, also yielded a considerable quantity. France has never been famous for gold; yet some has been found in a few of the rivers. At Gardette, in the hard rock, were some veins of native gold; but not in sufficient quantity to be worth the working.

A little is found in Mount Rosa, in Piedmont, just enough to pay for working. We find yet more among the craggy mountains in the Tyrol.

Hungary has been much celebrated for its mines, and not without reason. The modes of operating, and the machinery, are not equal to those in use in England; but they are very carefully wrought. It is supposed that nearly £600,000, in gold, is raised every year at Schemnitz and Cremnitz. One third as much of silver, besides lead, are drawn from thence.

These are the only gold mines in Europe, of any importance.

Sweden has some gold mines at Edelfors. Here is native gold, in veins, traversing a rocky mountain.

Russia has a mine at Voetsk, north of the lake Onega; but not in sufficient quantities to be worth the working.

In Scotland, gold was found, ages ago. And in the reign of Elizabeth, considerable quantities were collected between Leadhills and Elvanfoot. The traces of the works then carried on yet remain. The gold was found immediately under the vegetable soil. Hither a small stream of water was conducted, in order to wash away the light earth into pools, or basins, dug on purpose; in this state of loose mud, the heavier particles sank in the pit, while the mere earth was carried off. All those heavier matters

which sank, were afterwards well washed, and examined; as then the grains of gold would be found. Gold is still found in Scotland; but the increased expense of seeking it, renders the search unprofitable. Some of those who work in the adjacent lead mines, amuse themselves in their spare time, and now and then pick up a little.

Much was said, a few years ago, concerning the mountains of Wicklow, in Ireland. There some large lumps of gold were found, in a sandy soil. Several were of an ounce weight, and one lump weighed twenty-two ounces. This is said to be the largest mass of native gold ever found, any where.

We expect to find gold in Asia; especially as all our histories of the earliest ages, even long before Nebuchadnezzar's golden image, ninety cubits in height, was erected, speak of

gold being in great plenty. Solomon made it to abound so that silver was little thought of. Nay, as far back as the time of Moses, and the erection of the Tabernacle in the Wilderness, we find it in plenty. The whole continent of Asia seems to furnish it; from Siberia to India, and from the western provinces to Japan. The mines of Beresof, in Siberia, are still wrought; those of Tcherepa Nafskoy are very rich in gold. In the southern parts, as in India, many rivers furnish the precious grains. A river in Lydia, called Pactolus, which empties itself into the Archipelago, was famous in ancient story for its golden sands. The river runs by Sardis, and is said to have been the chief source of the long famous riches of Crœsus. In the East, in the islands of Japan, Vonnosa, Ceylon, and most of the isles in the Eastern Sea, much gold is found at the present day.

Africa has always been rich in gold. The ancients had much from it. That Ophir, from which Solomon received his supplies, is thought, with great probability, to have been on the eastern coast, somewhere about where Sofala now stands. Gold is still an article of commerce with all the Cafilas which traverse its dreary deserts. This is evidently the produce of the rivers; as it comes only in the shape of dust, or very small grains. It is brought for sale in quills of the ostrich and the vulture. The centre of Africa has always been esteemed rich in gold. Herodotus tells us, that the King of Ethiopia brought to Cambyses all his prisoners bound with chains of gold. That part of Africa, which lies more to the southward, which we trade with on the western side, by the ports of Guinea, Upper and Lower, produces much gold from its rivers, such as the Senegal, the Gambia, and the Niger.

GOLD.

MEXICO.

At the present day, we turn our eyes to the New World, in search of golden treasures. Ever since the discovery of America, gold has been the grand object. That those regions abounded in this splendid metal, we have undeniable testimony to prove; the quantity discovered in use there, and the quantities gained from thence every year, establish this point beyond contradiction. It is said, that, in gold and silver, America sends annually to Europe, £24,000,000 sterling in value.

When Cortez landed in Mexico, the most costly presents were made him by the natives, in the hope of civilly prevailing with him to depart; but thevalue of these presents determined

him to stay in a country where such magnificent commodities could be procured. Among them, were two large plates; one of massive gold, representing the sun, and one of solid silver, for the moon; and boxes filled with grains of virgin gold, just as they were found in the rivers. Even the governors of the provinces made him presents of immense value, in gold; which, though known to be in high esteem, was in that country plentiful.

The description of Mexico itself, its palaces, and its temples, evinces the great abundance of gold in the massy ornaments, glittering on every side.

When Cortez retreated from Mexico, he left behind him, above what the soldiers could carry away, gold, &c. to the value of £200,000; and in stripping the slain, after the battle of Otumba, his soldiers gained an almost equal value.

As gold was their principal object, they, soon after gaining the country, searched for the mines themselves, those hidden treasures; and forcibly obliged the natives to dig in them. It is calculated that forty thousand of them are kept to this labour, in New Spain only.

The principal mines are situated inland, far from the sea; in the provinces of Zacatecas, New Biscay, and Mexico Proper. But the veins of gold are small, and the produce uncertain. It has been observed, that gold mines have generally ruined those who engaged with them; although the purifying of the ores is not so expensive as with other metals. This happens, because the veins are very apt to fail. For a while the vein will be full and rich, and then it is lost on a sudden: when indeed they can trace a vein to its end, they frequently find what is called the *purse* of the mine, or

such a considerable quantity, as makes the fortune of the miner at once.

These mines are not wrought at the public expense; but any man who suspects gold in any place, may obtain a grant of the land; only obliging himself to begin working within a stipulated time.

The gold here, as in other parts of the world, is found in two different states; either within the rock in veins, or scattered in morsels in the sands of rivers. When obtained from the rocks, which must be burst asunder to get at it, it is sometimes found in lumps, or masses, of pure metal, called *native gold:* but more frequently in a mineralized state, mingled with other substances, as earth, stone, sulphur, &c. In this state, it would not be recognized by an ignorant person; for it is red, white, black, as may

Breaking the Gold Sticks in a Mortar

happen, and does not shew any of its brilliancy or metallic character.

When the gold is found in this state of mixture, the ore is broken to pieces, in a mill, consisting of an upright circular stone, which turns on its axis, while it traverses a circular trough; such as is employed to grind bark in England. When thus broken, some of the refuse is easily separated from it. To the remaining mass a considerable quantity of quicksilver is added: this, having a strong attraction for gold, fastens upon every particle of it, and draws it away from every thing to which it had been formerly attached.

When the gold is thus amalgamated with the quicksilver, a full stream of water is let into the vessel, which carries with it the lighter matters, earth, &c. and leaves at the bottom

the heavy metal: the amalgam, thus cleansed, is squeezed in a cloth; much of the quicksilver is thus forced out, and the remainder is driven off by fire, which leaves the metal pure.

When they are apprehensive of gold in the bed of a river, they turn the stream away from those spots in which they conceive it to lie. Then they loosen the bottom of the river, by digging. In this loosened state it is easily carried off by the current: when this soil is washed away, they come to a stiff earth, in which the gold is found. Again they turn off the waters, and dig up this earth, which they carry away to the *lavaderos*, or washing places. Here it is kept continually stirred with iron hooks and rakes, while water, rushing in, carries away the earthy matter: the gold by its weight falling to the bottom. But it is still mingled with a black heavy sand, which hides the gold, unless

there be a few lumps larger than the general size. To separate it from this sand, some of it is put into a shallow dish, which is deepest in the middle; this they fill with water. With their spread fingers they whirl the whole round and round; the water and sand pass over the edges of the dish, and thus the pure grains of gold remain in the central hollow. This gold is obtained without quicksilver, or fire.

GOLD.

PERU.

If we pass to South America, we may, in a similar manner, contemplate the conquests of Pizarro; and we shall find a great display of its golden treasures. When he first seized the too credulous Atahualpa, after murdering thousands

of the unresisting Peruvians, the spoil taken from the slain amounted to such a mass of wealth, as made the Spaniards almost frantic with joy. The captive monarch, finding that gold was their grand object, hoped to gain his liberty by offering an immense ransom. The room in which he was confined measured twenty-two feet in length, and sixteen in breadth. Atahualpa offered to fill it with golden vessels as high as a man could reach. He sent messages through all his dominions, and from the palaces of his nobles, and the temples of their gods, came the golden vessels, in obedience to his orders. After one fifth had been deducted for the use of the King of Spain, the value which Pizarro immediately shared among his party amounted to three hundred and twenty-six thousand six hundred pounds sterling.

When he took possession of Cuzco, the booty

he found there greatly exceeded in value what he had forced from Atahualpa. Plates of gold and silver covered the walls of their temples, and the shrines of their idolatrous worship.

The gold mines of Peru are situated chiefly in the northern provinces, almost in the neighbourhood of Lima. These mines tempted many to devote their whole strength to them. But this mode of advancing their wealth came into disrepute, from the unhappy experience gained, which proved, that although a few large fortunes had been realized, yet the great proportion of persons engaging in them had spent their property, and were reduced to great indigence. Indeed, to prevent their being abandoned, the government was obliged to remit the fifth, which had been previously claimed; and be content with a twentieth of the metal extracted.

In the more northern provinces of South America, much gold is found. In the province of New Granada, near Santa-Fé-de-Bogota, it is obtained from alluvial soils, and cleansed by simple washing. It is found in considerable plenty near Pampeluna, where a single labourer has sometimes found as much as was worth two hundred pounds, in a day. One lump of virgin gold was brought from Santa Fé worth almost eight hundred pounds sterling.

GOLD.

BRAZIL.

But the greatest quantity of gold brought into the market, in the present day, comes

from Brazil. The discovery seems to have been thus: a party of soldiers, sent into the inland provinces, to quell an insurrection, found some fish-hooks made of gold, among the natives; on inquiry, they were informed that the gold was brought down from the mountains by the floods, when the torrents came rushing into the valleys. This was enough to instigate a diligent search. It is true, few veins of gold were discovered; but the quantities of grains found after the floods exceeded belief. This searching for gold is the employment of negroes, who have this privilege, that if any one brings the quantity required of him, his master cannot demand of him any more. Should he find more, therefore, it becomes his own property; and, if he can save enough of it, he may purchase his freedom.

The registers of the fleets shew, that in about sixty years after the discovery of the

gold mines of Brazil, the value of bullion brought to Europe amounted to upwards of one hundred millions sterling. It is seventy years since that calculation was made; how much more must have been brought in that time!

Pudjee discovering the Silver Mine of Potosi

SILVER.

POTOSI.

"Now we are in South America, we may as well notice the silver mines of that country. We can leap over the Andes easily, as we sit here; and come at once to Potosi."

JAMES.—"I think, I remember something about Potosi, Papa."

"Well, let us hear all you can recollect."

"Why, I think, an Indian,—what was his name?—O, Hualpa,—was scampering up the side of a mountain, after some wild animal or other: finding it had jumped up a steep place quicker than he could, and determining to follow it, he laid hold of a branch of a shrub, to assist

him in climbing. But, instead of assisting him, it broke off in his hand, or rather it was torn up, root and all, out of the earth. He was, however, repaid for his disappointment, by the sight of something bright in the hole which the plant had come from. He soon discovered this to be a lump of silver; and he found several small bits sticking about the roots. These he picked off carefully,—that he took up lovingly,—and home he went joyfully! Right glad was he to have found such a treasure."

"What, then, did he keep it all to himself?"

"No, Papa. It would have been better for him, if he had. He returned to his mine whenever he wanted cash; and by that means grew so much better in his circumstances, that his neighbours wondered at it. One of these was his particular friend: so, whether to stop his inquiries, or to give him a share, I do not know;

but he told him of his discovery, and shewed him the place; and they both helped themselves as they happened to want."

"Well; but as there was enough for both, was it not better to let his friend have a share?"

"Yes, Papa, I suppose so, if he could have been sure of his friend. But some disagreement between them arose, because Hualpa would not tell how he purified it; then this unworthy friend went and told the whole to a Spaniard. The mine was soon taken possession of, and the poor Indians did not get any more. The mine indeed yielded a great deal, but the Spaniards took it all. This was in 1545.

"And, Papa, does that same mine continue to yield silver still?"

"They soon put its productiveness to the trial; for a town was built at the foot of the mountain; ten thousand Spaniards settled there,

to gain the silver; and sixty thousand poor Indians were forced to go thither, to dig out the ore. This mine is still worked, as are several others, in the adjacent mountains. The country around is barren, as is usually the case where there are metallic mines underneath.

" This mine is in a mountain by itself, like a sugar loaf in shape. The city of Potosi, although at the foot of the mountain, is not in a valley, but high up the Andes, whose white tops, covered with snow, glitter at a few miles' distance. It is now a large city, containing a hundred thousand inhabitants, including slaves. It does not belong to the western or Peruvian coast, but to the eastern side of South America, being in the government of La Plata.

" The mountain itself is about eighteen miles in circumference at bottom. The miners do

not proceed in any regular or scientific manner, but they get as much silver as they can obtain easily; none of them have penetrated above seventy yards into it, though there are more than three hundred pits; but they content themselves with scooping out the mere surface of the hill. An old conduit, which, a hundred years ago, led into several mines, is now filled with water, there not being any sufficient machinery to clear it off. The mountain itself seems to be a mass of clayey slate, yellowish and hard. Although it has produced so much since it was opened, yet it yields only about six or eight ounces of silver in five thousand pounds weight of the ore. All the processes for roasting, amalgamating, or refining the ore, are conducted in a slovenly manner, by persons ignorant of all scientific modes of operation. They mingle quicksilver, to extract the metal,

as is done with gold; but they do not get half the silver out again; and the waste of quicksilver is enormous. All the tools too, with which the poor Indians work, are heavy and unsuitable.

"Some German miners have been over there lately, who are shewing them how to conduct the works in a better manner. If proper improvements are made, the produce may become at least double in its value.

"We may mention too the mine of Laycacota, which was discovered in 1660, near the town of Puna. Here the virgin silver was in such abundance, that they cut it out with the chisel. The proprietor of the mine, with a liberality rather uncommon, permitted his countrymen, who came from Europe to seek their fortunes, to work in it a certain number of days, and take all away they thus dug out, without weighing or exa-

mination. This generosity brought plenty of visitors, and they soon began quarrelling with each other about their shares. Disagreements about such valuable spoils brought on blows; they armed themselves, in order to repress their neighbours' avarice; and in the end, the good-natured Salcedo, the original proprietor, was himself hanged, as the author of those tumults; although he had endeavoured all he could to prevent them.

"Peru is said to contain sixty-nine mines of gold, and seven hundred and eighty-four mines of silver; all of which are wrought, more or less."

SILVER.

MEXICO.

THERE are silver mines in Mexico, as well as mines of gold. Indeed, silver, although the second in rank, is the first in importance in a commercial point of view, on account of the much greater quantity yielded of it in the mines.

Silver (as are most other metals) is found in a variety of different ores. It is sometimes pure, or in veins which penetrate every crevice of the stony rock in which it is rooted; but, more frequently, it is mixed with other matters, which must be separated from it; so that its first appearance varies much, as it is ash-coloured, reddish,

bluish, often black, and sometimes in pointed forms, like crystals.

The manner of refining it differs but little from the processes used with gold; except that none is obtained by mere washing, though they clear it from earthy particles with water. They depend chiefly upon amalgamating it with quicksilver: but in this case there is more difficulty than with the gold; as the silver clings more powerfully to the mineral substances with which it is united. The process requires more care.

The mines of Spanish America are wrought by private adventurers, who are encouraged to the work by grants of the land to those who suppose they have made a discovery, and are willing to seek wealth in this mode. The governor of the province allows his claim; only binding him to begin in a stipulated time, and

insuring one-fifth of the produce to the King. There are always persons bold enough for such an undertaking, seeing it is so easy to make the experiment, and seeing too that, now and then, vast fortunes are realized by such speculations. Indeed, so fascinated are the Spaniards, who go over from Europe, by this silver dream, that they neglect that more certain produce, which the surface of the earth yields to the labours of the agriculturist.

SILVER.

NORWAY.

A SILVER mine of much celebrity is found in Norway, at Kongsberg, in the province of

Aggerhuuys, not a great way from Christiana, the principal seaport of that country. Kongsberg has the river Lowe running through it. It may contain about six thousand inhabitants, of which number the miners are nearly half; the mines are about two miles from the town. There are almost forty mines in work, the principal one is called Segen-Gottes. This is nearly seven hundred feet in perpendicular depth below the surface of the earth. In many parts of the descent, a staircase is cut in the solid rock. The mouths of the mines are made very wide. Working the mine is very laborious, because of the hardness of the rock; but they are not much troubled with water to flood the works, which is a great advantage.

Pounding the ore is one sort of process in

use here, as in most places. It is also smelted with lead, to separate it from extraneous matters.

Pure silver is sometimes found in feathery clusters, or foliage; but chiefly in small grains. Once, indeed, a large mass was found, valued at six hundred pounds, as pure silver. This, as a great curiosity, is preserved in the King of Denmark's cabinet, at Copenhagen.

The expenses of working this mine amount to as much as the silver, when brought to market; so that the government, at whose expense it is conducted, gains but little by it. The chief use of it is, to find employment for some thousands of poor people, who otherwise could have no means of maintenance; and to bring a quantity of specie into circulation, as that, though very necessary, is a very scarce

commodity; commerce being carried on chiefly by paper notes.

The mine was discovered in 1623; a town was immediately built, and a colony of German miners was sent thither. There are twelve veins and forty shafts. Some gold has been found here among the silver.

One of these mines is called "Old God's blessing;" this is still very rich. With some anxiety, the traveller descends above a thousand feet deep into the earth. When he arrives there, he finds a space cleared out, of several hundred fathoms in extent. In this gloomy cavern, he sees fires blazing all around him, in thirty or forty different places; these fires are kept up, in order to soften the rock, and make the work easier to the miners. The swarming of hundreds of miners, blackened with the

smoke, passing about on every side, adds to the awfulness of the scene, and helps to give it so much the more resemblance to what imagination had formed of the infernal regions. This becomes heightened, when a mine is sprung, to blast the rock with gunpowder; as then several hoarse voices cry out, "Take care of your lives!"

SILVER.

SWEDEN.

If we pass into Sweden, in search of silver, we must stop at Saalberg, near the town of Sala, in Westermannia. This is the only one rich enough to be worthy of our notice; and this is so ancient, that no records tell us of its dis-

covery. The depth of the mine is almost a thousand feet; there are some landing-places, so that the miners do not descend the whole depth at once; which is, to our apprehension, so much the better, because they are let up and down in baskets in two considerable lengths of the descent, though they have ladders in a few places.

The inside of this mine is very grand; the roof looks like that of some old Gothic cathedral, supported by slender pillars of ore, left in regular order. The brilliant masses, glittering all around, arouse our admiration. The ore seldom yields above four pounds of silver in the hundred weight, and requires much trouble to obtain it.

In times past, the scoria were thrown away; but a German has discovered a method of extracting silver from that which was once

thought to be rubbish. How frequently do we see ignorance improvident, while knowledge is ready to turn almost every thing to account!

SILVER.

RUSSIA.

Russia has some silver mines; those at Kolyvan are the most important. These are far off, in Siberia, in mountains adjacent to Chinese Tartary. They were discovered by Akinsi Nikitich Demidoff. For some years, he gave out that they were copper mines, and worked them on his own account. Being afraid, however, of being discovered and punished, (because all gold and silver mines belong to the crown,) he himself gave in an account of them to the

Empress Elizabeth, who of course seized upon them, as her own property. There is but little wood near the spot; therefore, smelting works have been erected at Novopaulofsk and Susunsk, in the neighbourhood of forests, whither the ore is transmitted, to be smelted and purified.

These mines may be called the Potosi of Russia. They produce nearly ten thousand pounds of silver annually. When this silver comes to Petersburgh, it is smelted again, in the imperial laboratory; and it yields three per cent. of gold. So that in that quantity of silver, there are twelve or fourteen hundred pounds of pure gold.

The mines of Kolyvan employ nearly forty thousand persons (without reckoning the peasants of the adjoining districts, who pay their poll-tax in wood and charcoal,) in bringing these materials to the place, and in transporting the

ore to the smelting towns. A mint is established at Susunsk, where the coinage of the copper obtained from the same mine is performed. The silver produced here is conveyed to Petersburgh on large sledges, a convoy of which sets off twice a year.

Still more to the eastward, in the province of Dauria, the south-easternmost part of Siberia, between the rivers Shilka and Argoon, are the mines of Nertchinsk : these were opened in 1704. The annual quantity of silver produced, on an average, is about sixteen thousand pounds, besides the gold, amounting to five hundred pounds, which is obtained from it when refined a second time at Petersburgh.

LEAD.

DERBYSHIRE.

THERE are many wonders in the county of Derby, and about the Peak. Curiosity, rational curiosity, may have a feast, whatever be the peculiar taste of the party. Pleasure and amusement are all that some pursue; and if these can be brought to bend to any attainment of rational knowledge, it is well. Some of the curiosities are rather of an alarming nature; we can hardly recommend them to many persons, especially the young and the feeble. It is well for such, that travellers of more strength of

constitution, and firmness of nerve, have been there before us.

Mam Tor, or the Shivering Mountain, afforded them much amusement; as did several others of these wonders of nature. But the present object of our inquiry is, the nature and appearance of mines.

Mam Tor is seen at a distance, towering above its neighbouring mountains, and rising to the height of thirteen hundred feet above the valley.

Now near the bottom of Mam Tor, is a very ancient and a very curious lead mine. It seems to have been wrought at least as far back as the time of the Saxons, for it bears the name of Odin: yet it affords to the present day employment to a tolerable number of people.

There are two levels, as they are called: one is a passage for carts, by which the ore is brought out of the mine; the lower one is a

water drain, to keep the mine in a proper state for working. These levels penetrate above a mile into the bowels of the mountain, running horizontally.

The ore is of that sort called *galena,* having a fine polish, almost equal to a mirror; it is here known by the name of *slickenside.* One great peculiarity consists in its aptitude to explode. When a sharp iron wedge is driven into it, it begins to crackle; in a few minutes the rock will burst, and fly all to pieces, as if it had been blasted with gunpowder. The miners must hastily get out of its reach, or they may suffer for their temerity.

In the mines at Eyam, in this neighbourhood, a violent explosion of this nature took place in the year 1738. Then the surprising quantity of seven or eight hundred weight of mineral matter was thrown out at one explosion. The

concussion was so great, that the upper surface of the ground was seen to shake, as if an earthquake had happened.

LEAD.

STAFFORDSHIRE.

One lead mine is called the Staffordshire Speedwell, the entering into which is amusing. "We put ourselves under the guidance of the manager, who conducted us through an opening, down above one hundred steps, formed almost perpendicularly. At the bottom of this descent was a river, and a boat ready for us, with a boatman in it. A parcel of lighted candles were prepared: we each of us took one. The river, and the boat, and the rough boatman,

thus in the lower regions, put us in mind of the ancient heathen fables, of the dead being ferried over the river Styx, by Charon. The boat was presently pushed off; the man giving it its motion by the help of sticks stuck in the rock, five or six feet asunder. We were shoved along thus for some considerable distance. Strange were the sensations occasioned, by our thus swimming along in the bowels of the mountain. The scene was sublime certainly, and awful.

"While on our subterraneous voyage, we were surprised by the sound of a sweet voice, which had almost a magical effect, as it lost itself among the arches of the cavern's roof. We approached nearer to it as we went on, and found a fine little fellow, of about twelve years old, placed in a small niche of the rock, who was soothing himself in his monotonous labour, by singing.

His business was to work a pair of bellows, which, by a long pipe, conveyed fresh air to the deepest recesses of the mine. He had to keep at his station for eight hours, working and singing. We passed in this manner almost half a mile, and at the end of that voyage found the miners at their work.

"There are several veins of lead among these rocks. The rocks are split by gunpowder; the broken masses are then cleared away.

"When we came to the extremity of the mine, where the men were at work, we found the benefit of the little songster's labours, in sending a supply of fresh air. The air in such a long cavern becomes thick, and damp, and would be very dangerous to the miners; but this constant renewal of it, by a pure stream from the open atmosphere, keeps it wholesome."

There are mines of lead in many other parts of England, as Cornwall, Staffordshire, &c.

There are also lead mines in Scotland, which are productive and lucrative.

There is, however, so much similarity in them, that the description already given may well suffice for all.

LEAD.

SIBERIA.

At Nertchinsk, in the south-eastern part of Siberia, are mines belonging to Russia. These have been mentioned as producing silver. They have much better right to be mentioned for their greater productiveness in lead. Silver

and lead are often found mingled together. These ores at Nertchinsk are very poor in silver, and rich in lead. The silver is of most value, and is taken to Petersburgh to be refined; but there are many million hundred weight of lead left on the spot, after the silver has been extracted. Some, to the amount of five or six thousand hundred weight, are carried to Kolyvan, to have the silver separated from the copper, at the founderies. But the expense of carriage prevents its being transported into the heart of the empire, and there is an absolute prohibition against its being sent to China; so there it remains useless.

The persons employed in these mines amount in number to almost fifteen thousand. Nearly two thousand are free colonists; more than one thousand are convicts, condemned to this work;

nearly twelve thousand are peasants of the country round about; employed especially in cutting wood, and in making and carrying charcoal. These last also cultivate more or less ground, and find a ready sale for the produce at the founderies.

QUICKSILVER.

PERU.

QUICKSILVER, or, as in mineralogy it is called, Mercury, is of great use in obtaining other metals, as well as very serviceable in itself. It has a great affinity to gold, and to silver especially: without the aid of this mineral, it would not be easy to obtain those more precious commodities. The silver mines of Potosi would have been almost useless, had there not been discovered, in the same country, a mine of quicksilver.

This mine is situated at Guanza Velica; it has been worked almost three hundred years, and does not seem to diminish.

When you come fairly into the mine, you find a subterraneous city, having broad streets, open squares, and a chapel, in which all the superstitious mysteries of the Romish religion are performed, especially upon high days. As all this is wholly under ground, thousands of flambeaux are kept continually burning, in order to give light.

The ore in which the quicksilver is contained is earthy, of a whitish red colour, looking like burned brick. This is pounded small. It is then put into a kiln, somewhat in shape like an oven; the bottom is an iron grating, covered with earth. Under this, a gentle heat is kept up, with a herb which grows in that part of the country; and, being deemed most suitable for this business, persons are forbidden to cut it for other purposes, for sixty miles around. The heat thus communicated to the pounded

ore, sublimes the mercury, and makes it rise with the smoke. This smoke can only pass off through a very small hole, which is connected with a number of retorts, or earthen vessels with long necks, each having a little water in its lower part. The water cools the smoke, which then lets the small drops of quicksilver fall into each retort; and these drops, being extremely heavy, fall to the bottom of the vessels, where it is gathered easily together, into one mass.

This mine is not wrought by the government, but by private persons, who are, however, hindered from gaining such profits as might be expected, because they are obliged to sell the whole produce to the king at a stated price. Besides which, when the government has obtained all that is wanted for the mines, the work is suspended.

There is no mineral product so noxious to those who procure it as quicksilver. The miners suffer dreadfully from tremors, languors, and convulsions. It is, therefore, the native Indians who are obliged to labour in this dangerous occupation. These poor victims of avarice and oppression work naked, in the bowels of the earth, where it is exceedingly cold. It is true, their services are, nominally, for only six months, though they are often kept longer. But many do not survive this period: and such as outlive it, are reduced to so languid a state, that they seldom return to their homes and connections, but settle in the neighbourhood of the mine, and become slaves for the remainder of their miserable lives.

QUICKSILVER.

IDRIA.

THERE is also in Europe a mine of quicksilver, of considerable importance; it is situated at Idria, in Carniola, and belongs to the Emperor of Austria. We may take our account of it from a traveller, who visited the place. "Persons condemned for certain crimes are sent to labour in these mines: which is a state of prolonged sufferings, containing many daily deaths in one. They labour in darkness, or, at least, far from the light of the sun, toiling out a miserable life, under the whips of hard-hearted taskmasters. The entrance is in the side of the mountain, at a hole about fifteen feet wide.

The conveyance to the mine below is in a bucket, to a depth of more than six hundred feet. The opening widens as you descend, but becomes more and more gloomy as you leave the light. After a pretty long swing in this manner, you touch the bottom; but the ground on which you tread sounds hollow. The sounds of your own feet echo among the gloomy caverns, like thunder. Feeble lamps are placed here and there, just sufficient to guide the workmen. But a person just descended from the surface, is not able to see any thing, not even the persons who come to conduct you about the place.

"The inhabitants of these gloomy regions are more gloomy still, not only from the squalid wretchedness of their appearance, but from the misery which their whole countenance exhibits. They would look pale as spectres, but

for the blackness which they contract in the operations of the mine. Those who are condemned hither are malefactors; their physiognomies may therefore be expected to be unpleasing, as exhibiting their vices strongly depicted. Added to this, dejection and exhaustion mark them. They soon lose their appetite, and the most robust constitutions seldom last above a couple of years; then death closes their melancholy sufferings, as to this world.

"These mines are among the greatest curiosities in the country; they were first discovered in 1497. It would take several hours to go through all the passages which have been scooped out in the bowels of the mountain. Two of the shafts, named from saints, are the principal openings.

"The quantity of mercury cleansed from the ore may amount annually to about two thou-

sand six hundred quintals. But much is caught as it oozes out of the crevices of the mine; this is called *virgin mercury*, and may amount to a hundred quintals, each quintal being about a hundred weight."

QUICKSILVER.

SPAIN.

In the province of La Mancha, in Spain, famous for the exploits of Don Quixote, and near the town of Almaden, are some mines of quicksilver, of considerable importance, especially to the Spaniards.

From them they obtain mercury in great quantities, by which they work their American mines of gold and silver. The quicksilver is found in a hill of sandstone; there are two

principal veins situated near together, and a third at about five miles' distance. They are worked on behalf of the king. An accident happened, in 1784, which let the water into the mines, and flooded them, so as to put a total stop to the works; and Spain was obliged to obtain quicksilver from the Austrian mines, for six years, at the rate of three hundred tons weight annually.

The mercury is here found, partly in a native state; they have only to catch it, and carefully gather the drops.

But it is chiefly in the form of cinnabar, which is a common ore of mercury; it seems to be mercury petrified and fixed with sulphur, from which it is freed by heat. One pound of cinnabar will frequently yield fourteen ounces of mercury, though sometimes not above ten.

These mines of Almaden produce cinnabar of the richest quality.

There are mines of cinnabar in other parts of Spain; one near Alicant, and another near Valencia; but they are not wrought. Near the latter place, too, virgin mercury is found, in a bed of ash-coloured clay.

SUNDRIES.

Although the principal mines and mineral substances have been thus fully noticed; yet it may be proper to say, there are many other mines, whence these commodities are obtained; but the description of them would be so similar to those already given, that it would be impossible to avoid tedious repetitions. All that is needful for the amusement and instruction of the young, is here selected.

It may, however, be proper to name a few other substances, such as are of frequent occurrence, in order to render this Volume worthy of its pretensions.

Sulphur is a substance of extreme utility,

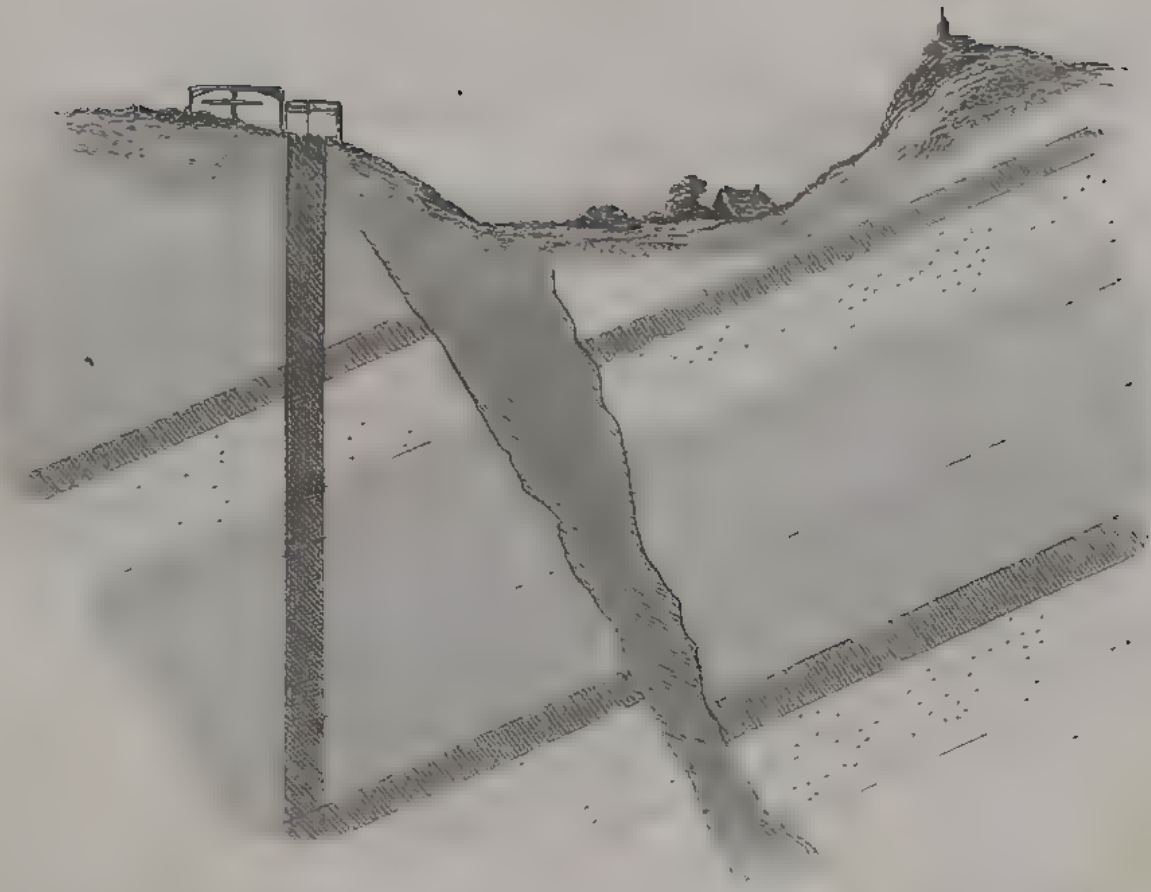
in arts, manufactures, and medicine. It is found native, in nodules, in layers, or in crystals. There are considerable mines of it in Hungary, Poland, Spain, Switzerland, and Sicily.

It is also sublimed by volcanoes, and is collected from among the lava; in Italy, near Vesuvius; also near Ætna, in Sicily; near Mount Hecla, in Iceland; and in several of the West-Indian islands. It is an important branch of commerce, wherever it is found in any quantity.

Plumbago, commonly called *black lead,* of which pencils are made, so excellent for drawing, is a very peculiar mineral. It is found in several countries, but best of all in England. There is a considerable mine of it in Cumberland, at Borrowdale, where it is found in detached masses. The mine is opened but once in seven years, and then carefully shut up again.

For usefulness, we may mention fullers' earth. It is to this substance, that England owes much of the superiority of her woollen fabrics. Nothing else does so well absorb all the greasiness which attaches to wool, either in its natural state, or in the manufacturing of it. A soft, smooth pliancy is hereby given to our woollen draperies. A similar earth is found in Sweden, Saxony, and France; but the best beyond compare is in England, especially in Hampshire, where there is a large and valuable bed.

Many ores of other metallic substances are found along with the principal ores, of which we have already treated: but, whatever might be their importance in a system of mineralogy, there is not sufficient difference in their situations in the interior of the earth, to warrant a specific description here.



THE MINE.

Beauteous is the landscape, as, from any gentle eminence, we cast our eyes over hill and dale, dark woods and golden harvest fields; the meandering river, or the close glen. Nay, the wide sea, monotonous as it is, fills the mind with sublime delight; we linger at the prospect, and are almost unwilling to return to the gay meadow, the close hop-ground, or the harvest-home.

It was not long, we may suppose, before man perceived, that, besides the immense and richly valuable products of the surface, there were treasures also in the bowels of the earth: for, so early as long before the general Deluge,

we find metallurgy was, to some efficient degree, understood. Tubalcain, the son of Lamech, was an instructor of every artificer in brass and iron, *Gen.* iv. 22.

That the ancients understood, in some tolerable degree, the art of mining, is evident from the metals with which they were familiar. And, although gold might be obtained, as it is most frequently now, from the sands of rivers; yet copper for brass, (if their brass were not really copper itself) must have been dug from the bowels of the earth.

The Phœnicians, we know, traded for tin, even as far as our Cornwall; where they either found or established regular mines.

The Romans found gold mines in Spain, and obliged the natives to dig out the precious metals for their tyrannical masters.

In modern times, mining is not only a con-

stant operation, but, by the joint assistance of geometry, mechanics, and chemistry, it is carried on in a higher manner as to science, and a wider scale as to commerce, than to the ancients ever was possible.

In order to conceive accurately of a mine, one should be aware of the general structure of the shell of our terraqueous globe; for it is only a little way into the shell, that man has ever been able to penetrate. The deepest mines are not so deep in proportion, as if the paper of a twelve-inch globe were to be excavated and undermined by some minute insect.

Since philosophic men have given due consideration to the structure of the earth, so as to form geology into a science, it is perceived that the surface, if it may be so called, to as great a depth as man has been able to penetrate, is composed of layers, or strata, of different substances,

placed over one another, like the flakes of a good pie-crust; and if it were a plum pie, the bumps in it would represent the hills and mountains. Each stratum is distinct from those above it, and from those below it. These different strata consist of mould, sand, clay, marl, chalk, stones, rocks, &c. In general, the heaviest lie lowest, as if the whole had been once mixed together with some liquid, and the ingredients had settled by their specific gravities. Sometimes, lighter strata are found far beneath the heaviest.

They do not appear in any settled order, as in the list of terms just given; but some are found in one country, and others, of a quite different character, in other parts. Now, let us suppose, that, by Betty's carelessness, a flat iron, or something as heavy, had fallen upon the pie-crust, above supposed, and had broken it down in some places, and forced it up in others. The flakiness

of the crust would still continue, though the parts which once joined would be now widely separated. This then would much resemble the crust of our earth; which has evidently suffered by some overpowering force, which has cracked and disjoined, and dislocated the various strata; turning them from their horizontal position, making some of them dip with a considerable slope, while others have been cast up out of their former place. We may naturally refer this to the universal Deluge, when "the fountains of the great deep were broken up."

These convulsions and dislocations have occasioned many cracks and fissures, in a vertical direction, more or less wide, and more or less deep. It is usually in such fissures, among the rocky strata, by miners called *lodes*, that metallic mines are found. It is also most common that these mines are situated

in mountains; at least they are, when so situated, most easily come at by man's feeble powers.

The inside of these fissures is commonly coated with a sort of rind, crystalline and earthy, which is called the *capel*, or *wall*. This seems to originate from the moisture oozing through the stratum and coagulating on the mineral substances. Yet these regular walls are seldom found but at some fathoms' depth.

Veins of metallic ore are often found in lodes, not an inch wide. Yet these, if followed, will frequently become very rich, and will reward the miner's fatigue and expense, in clearing his way, although, at first, it was very unprofitable.

That there must be considerable danger in digging thus into the deep recesses of the earth, may easily be supposed. One would think man was never intended to run his long

passages into the ground like a mole. Yet the substances found there are not useful to any but to him: and some of them, as coal and salt, not to mention iron, are of prime necessity; he would be uncomfortable without them, especially in climates far removed from the equator.

Descending deep into a mine, generally gives the sensation of chill; sometimes there is absolute ice: but on passing into still greater depths, the earth seems to become warmer, so that in some places the miners can scarcely bear any clothing.

The want of pure atmospheric air, in those far distant corners of the mine, is a great inconvenience, and tends to destroy life. Air is sometimes conveyed by a pipe, the mouth of which is on the surface, and is set open towards the wind; or by bellows, in a similar way.

But the impurities which load the air in

those deep recesses are among the most dangerous of the circumstances which the miner has to guard against.

The vapours arising from many of the metals are very injurious to health; as the complexion of most miners indicates, so pale and sallow. Coal mines are not, in general, so noxious as those of tin: copper is still worse than tin; but those most detrimental to health are the mines of quicksilver. This injurious substance insinuates itself into the very flesh and bones of the miners; carries off many quickly, or fills the hospitals with cases of extreme debility and suffering. As cinnabar, vitriol, bitumen, and arsenic, are most commonly found mingled in these mines, it may well be supposed that the effluvia from these substances must be deeply injurious. Frequently, these vapours are perceived by a fragrant smell, resembling the scent of pea-blossoms;

this name is, therefore, applied to it, and by it the miners have warning to escape for their lives. Such as are caught by it swoon away; and if removed to the fresh air, they revive under great agonies.

Carbonic acid gas, called by the miners the *choke-damp*, is found abundantly in most places which have been long shut up; such as cellars, wells, and especially mines. This cannot be breathed without instantaneous suffocation. Even vats in breweries are liable to it; and the loss of many lives has been the consequence. Charcoal fires emit it; as many have found, who have slept in rooms which have been aired with that material.

This damp, or fixed air, is very heavy, and sinks to the bottom of every reservoir wherein it exists. In a coal mine in Scotland, some miners accidentally broke a hole into an old mine

which had been long shut up; they soon perceived their danger, and escaped with the utmost expedition. The next day, eight of them went to continue their work, without any expectation of danger. They had, however, scarcely got to the bottom of the stairs, which led to their scene of operation, than they all dropped down dead, as if they had been shot. The wife of one of them, on being told her husband had been suffocated, in her anxiety, ventured down to discern where he lay. She saw he was nearest to the stairs of any of them; and wishing to rescue him if possible, she stooped to take hold of him; but the damp seized her instantly, and she fell dead by his side.

The *fire-damp* is hydrogen gas: this is lighter than the atmosphere, and always rises to the roof of the mine. If it gain access to a

candle, it instantly ignites, with a loud and very violent explosion. Persons involved in it, are scorched, more or less. The violence of the explosion is such, that persons who happen to be in its way in the mine, are blown out of it, to some distance; nor can the strongest and heaviest machinery resist its force. No smell is perceived before it catches fire; but there is a strong scent of sulphur after it. The colour of the flame is bluish, or greenish, and it is very brilliant. It is followed by a dark vapour, or smoke. These damps begin to arise about May, and continue during the summer, at uncertain intervals.

In mines liable to the fire-damp, one mode of prevention is, never to bring the flame of a candle into them. In order, therefore, to obtain light without flame, with great ingenuity, a large wheel is constructed, having its edge

stuck full of flints; in their way, a number of steels are placed, so that as it revolves, a continued stream of sparks is produced; by which glimmering light the miners are able to carry on their operations. Sparks will not set this vapour on fire. Lately, indeed, Sir H. Davy has invented a lamp, which promises to afford great security. It has been found that the dense vapour cannot penetrate between the narrow crevices of a fine wire gauze: this is, therefore, formed into a lantern, and gives safety.

That mode of safety which consists in having a stream of sparks, instead of a flame, would be of no use in some cases; where a spark would set the whole on fire. The workmen in such mines are so much afraid of this, that they take all the nails out of their shoes, lest some spark might be accidentally generated.

The history of mining affords melancholy instances of mischief done, by the falling in of the earth above; when it has not been well supported by props. This must sometimes be guarded against by thick planks, supported as a ceiling.

Again, floods of water sometimes burst in upon the men, and drown them; perhaps, also drown the mine itself, so that it cannot be used any more.

That men should think of digging into the bowels of the earth for such commodities, seems unaccountable: yet, possibly, accident, under the guidance of Divine Providence, might occasion at least the first endeavour of this nature. Ancient stories tell us, that, some Spanish shepherds having set fire to a wood, the conflagration heated the soil so much, as to melt the silver under it, and make it run into a mass.

Sometimes the sea has washed away the earthy parts of the shore, so as to throw daylight upon these treasures.

When men once became acquainted with these important mineral productions, they would naturally look again, and hunt in every place where there could be any hope of finding them. And, as they became better acquainted with the principles of chemistry, they became more adroit in turning to account all they found, and all they suspected to be of value. There is a sagacity, obtained only by being long accustomed to the practice, which enables some to say, with tolerable certainty, where the precious productions may be sought, with some confident hope of success. Certain metals are usually found in such or such kinds of soil, and never in others; which experience establishes as a rule.

The vicinity of copper ore is frequently ascertained by the harsh taste of the waters which flow near them. Or, if a piece of polished iron be immersed, where the particles of copper are floating, they will affix themselves to it decidedly. Or, a piece of tallow, put in, will in a short time become green.

Sometimes, in driving an adit from the lower grounds, to let off water from the mines, lodes are met with much more valuable than the one intended to be relieved.

THE MINERAL CABINET.

When "Yes," and "No," and "O dear, how pretty!" are all the effect produced by instruction, there is reason to fear that the labour and expense bestowed upon the lesson is nearly lost. It may, indeed, happen, that the memory may be roused, years afterwards, to recollect circumstances, facts, and reasonings, which occurred in childhood; although, apparently, they did not then make the deep impression wished for by the anxious tutor.

When, however, we see the pupil's own mind roused to action; and that he is diligently employing himself in some project, or some opera-

tion, suggested by the instruction received, and of a nature to clear the subject up to his own mind, or to fasten it well in his memory, we are sure he has received benefit.

It was, therefore, with considerable pleasure that his father, some time after their return, was introduced by James into his own study, (a closet a few feet square only,) to inspect a mineralogical cabinet, which he had constructed. It was about two feet high, and about twelve inches wide; its depth was one inch and a half. James had been accustomed to operate for himself; he could handle the saw and the plane adroitly, and make a joint with considerable neatness. The frame-work was mahogany. At the top was a pediment, in which was written MINERALOGY; beneath, were four compartments of bottles, answering to the four

classes into which mineral substances are conveniently divided; as Earth and Stones, Salts, Combustibles, and Metallic Ores. Each of these formed a row, whether consisting of many or fewer names; except that the last class, being more numerous, filled up three rows.

He had procured a sufficient number of wide-mouth square vials, all of a size, in which he proposed to keep his actual specimens. Some minerals he had procured; but to fill all the bottles would be a work of time; and some he had but small hope of obtaining.

To give, however, as much completeness as he could to his cabinet, he had labelled each compartment, and also each vial. The advantages of vials were many; as each subject could be distinctly seen, without danger of being lost or spoiled by incautious handling. Uniformity

and neatness were hereby well secured, as well as conveniency of inspection.

He had drawn up a written list of these, lest any of them should be disarranged; and, in order to make himself perfect in this classification, he would sometimes take all the bottles out of their places, and intermingle them upon the table, enjoining himself, as a task, to put each and all of them in its proper compartment, and in its individual place. He had attained to so much adroitness, that he already could do this without making many mistakes.

At a small price, and with little exertion, may any one thus obtain a general acquaintance with the wonderful productions found in the bowels of the earth; a sort of knowledge highly useful to many persons, and gratifying

to every intelligent mind, even if no absolute necessity for it should occur.

As his father expressed himself much pleased with this display of his knowledge and ingenuity, James took courage to develope a plan much more complete, which he had in his intention, which was, to have not a single bottle to each genus, but a drawer, containing as many bottles as there were important specimens in each genus. This might be attained by only giving depth to his cabinet. At present, he contented himself with having a large label pasted on the hinder part of each vial, on which was written a list of the various specimens most commonly named, belonging to that genus. Thus, on the genus Silica, or Quartz, was this list: *garnet, ruby, topaz, emerald, rock crystal, flint, pumice, feldspar.* In this first class are many names; each be-

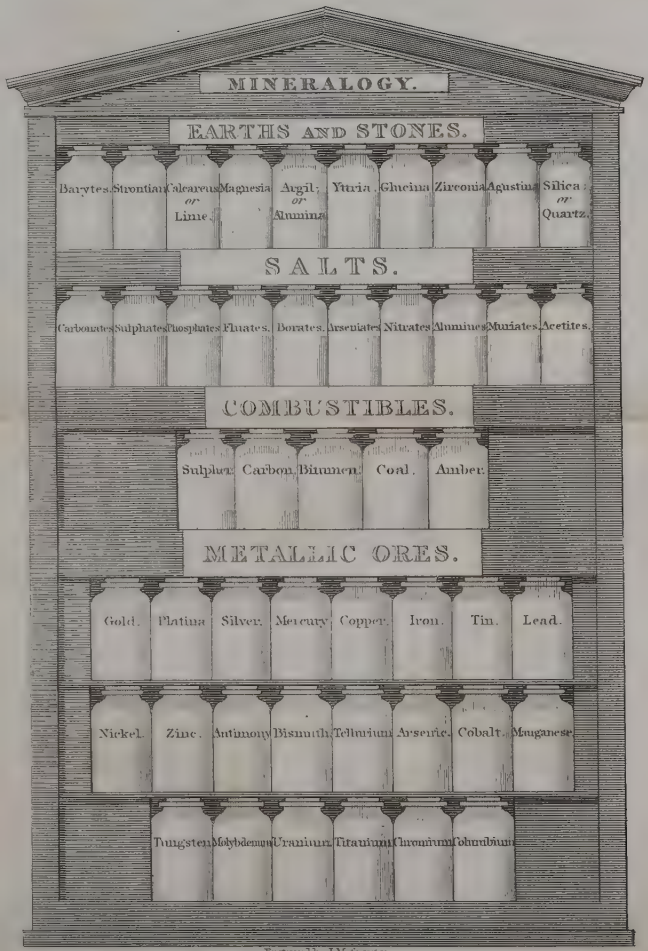
longs indeed to a family, and under each are many specimens: but to enlarge it thus, can only belong to a scientific mineralogist. For general knowledge, it is quite sufficient to select the most important specimens; or such as are most likely to be mentioned in conversation, or in books of travels.

He had also an alphabetical list of the names, with a reference to its class, and a short account of the qualities, localities, and uses of each.

We have given a representation of James's mineralogical cabinet, thinking some of our young readers might wish to make one like it. And, in order that the labels may be clearly understood, we give copies of them. The terms which follow each, express those specimens which are most commonly known, or are in more general use. These names were inscribed on

a larger label, behind the bottle to which it belonged.

Thus his mineralogical scheme was kept complete by the labels; even should he never be able to obtain half the specimens; and some of them, it was pretty certain, he would never possess: *diamond* and *zircon,* for instance.



Engraved by J. Metzenger.

CLASS I.—EARTHS AND STONES.

1. Barytes . . . . . Heavy Spar.
2. Strontian . . . . . Strontites Celestine.
3. Calcareus, or Lime. Chalk, Limestone, Marl, Fluor, Gypsum.
4. Magnesia . . . . . Magnesia, Fullers' Earth, Serpentine, Talc.
5. Alumina, or Argil. Clay, Tripoli, Slate, Mica, Basalt, Umber.
6. Yttria.
7. Glucina.
8. Zirconia . . . . . Hyacinth.
9. Agustina.
10. Silica, or Quartz . . Garnet, Ruby, Topaz, Emerald, Rock Crystal, Flint, Pumice, Feldspar.

CLASS II.—SALTS.

1. Carbonates. . . . . Native Soda, Native Magnesia.
2. Sulphates . . . . . Native Vitriol, Alum, Epsom Salts.
3. Phosphates. . . . . Animal Earth.
4. Fluates . . . . . Cryolite.
5. Borates . . . . . Borax.
6. Arseniates . . . . . Salt of Arsenic.
7. Nitrates . . . . . Native Nitre, Saltpetre.
8. Alumines . . . . . Pure Clay, Base of Alum.
9. Muriates. . . . . Rock Salt, Sea Salt, Sal Ammoniac.
10. Acetites . . . . . Verdigris, Sugar of Lead.

CLASS III.—COMBUSTIBLES.

1. Sulphur . . . . . Native Sulphur.
2. Carbon. . . . . Diamond, Mineral Charcoal.
3. Bitumen . . . . . Petroleum, Mineral Pitch.
4. Coal. . . . . Jet, Cannel Coal, Common Coal.
5. Amber . . . . . Common Amber.

CLASS IV.—METALLIC ORES.

1. Gold.
2. Platina.
3. Silver.
4. Mercury.
5. Copper.
6. Iron.
7. Tin.
8. Lead.
9. Nickel.
10. Zinc.
11. Antimony.
12. Bismuth.
13. Tellurium.
14. Arsenic.
15. Cobalt.
16. Manganese.
17. Tungsten.
18. Molybdenum.
19. Uranium.
20. Titanium.
21. Chromium.
22. Columbium.

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